PROVIDER AND CONSUMER PREFERENCES IN HEALTH CARE MARKETS

Dissertation
for the Faculty of Economics, Business Administration and Information Technology of the University of Zurich

to achieve the title of
Doctor of Philosophy in Economics

presented by
Maurus Rischatsch
from Vaz/Obervaz

approved in April 2012 at the request of
Prof. Dr. Peter Zweifel
Prof. Sandra Hopkins, Ph.D.

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The Faculty of Economics, Business Administration and Information Technology of the University of Zurich hereby authorises the printing of this Doctoral Thesis, without thereby giving any opinion on the views contained therein.

Zurich, 4.4.2012

Chairman of the Doctoral Committee: Prof. Dr. Dieter Pfaff

Preface

During my time as a Ph.D. student and research assistant at the University of Zurich and my visiting scholarship at the University of California at Berkeley, I have benefited greatly from the help and advice of many people to whom I wish to express my gratitude.

I would like to thank my thesis supervisor Professor Dr. Peter Zweifel for his invaluable support and intellectual input. I am indebted to him for his guidance and advice about the essays in this dissertation and that he gave me the opportunity to study at the University of California at Berkeley. I am grateful that Professor Sandra Hopkins from the Curtin University in Perth (Australia) co-supervised this dissertation and that she was willing to co-examine my oral defence. Dr. Maria Trottmann (co-author of Chapter 5) was of great value sharing her profound knowledge about health insurance related topics. I appreciate Dr. Harald Telser's inputs and encouragement. His fascination for health economics and econometrics inspired me from the first day at the chair. In addition, I would like to thank my former and current colleagues at the Chair for Applied Microeconomics (in alphabetical order), Dr. Patrick Eugster, Dr. Boris Krey, Dr. Ilja Neustadt, PD Dr. Felix Schläpfer, Dr. Johannes Schoder, Dr. Michele Sennhauser, and Dr. Philippe Widmer as well as Christoph Kuhn, Philipp Morf, Adrian Rohner, and Micha Ruflin from the Chair for Economics of Innovation and Economy of Switzerland. Working as a student assistant at the Swiss Banking Institute, Dr. Christian Kruse motivated me to start with my doctoral thesis. The same is true for Martin Peter from Infras where I wrote my master thesis. I also want to thank the whole team at the library of the Department of Economics for supporting me with articles and books, and the team at the dean's office for its administrative help.

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During my time as a Ph.D. student, Thomas von Stokar (Infras) and Dr. Stephan Vaterlaus (Polynomics AG) made it possible to work on projects commissioned by public authorities as well as private companies. These projects gave me the opportunity to collect first insights into non-academic consulting.

I would like to thank my mother Maria Rischatsch and my sister Riccarda Capaul for their encouragement and continuous support. Finally, a thank you goes to Nina Aemisegger, Barbara Spiegel, and all my friends for backing me up during my doctoral studies.

Maurus Rischatsch, Zurich, October 2011

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Chapter 1

Introduction

In almost all industrialized countries, health care expenditures are rising at a faster rate than gross domestic product. Switzerland is no exception, and OECD (2010a) statistics for the country show the third highest spending per capita behind the United States and France. Consequently, health care reforms trying to contain medical expenditure are at the top of the political agenda in Switzerland. However, it is important to note that high health care expenditures are not bad per se. If citizens' preferences point to a willingness to pay high insurance premiums (or taxes) for health care consumption, reforms with the objective of rationing health care provision may decrease a nation's welfare. Therefore, policy makers should never design reforms only considering cost and neglecting citizens' preferences.

This dissertation is a collection of five essays and purports to provide information about providers' and consumers' preferences for conventional health care provision and for possible changes therein. In contrast to stated preferences, revealed preferences are measured using observed instead of hypothetical choices. Unfortunately, measuring revealed preferences is often impossible because choice alternatives of interest are not on the market yet. While evidence based on actual behavior (revealed preferences) would be preferable in principle, market experiments (stated preferences) can inform policy makers and health insurers about the chances of success of planned reforms and changes, helping them avoid costly failures. On the provider side, Swiss physicians' preferences for Managed Care (MC) participation, acceptance of budgetary co-responsibility, and choice of pharmaceuticals is investigated. On the consumer side, citizens' preferences for health insurance policies are measured to predict their resistance against MC-type restrictions. This allows the estimation of implementation costs for introducing incentives and to compare them with expected savings.

Two different types of data are used in this thesis. Experimental data from discrete choice experiments constitute the first type and are used along with stated preferences methods to expose hypothetical preferences (Chapter 2, 3, and 4). This data provides information about what providers or consumers say they would choose. In contrast, the second type is drug claims data. This data contains non-hypothetical choices that were actually made. This type of data is utilized to study physicians' revealed preferences for drug versions (Chapter 5) and package choices (Chapter 6) to analyze their prescribing behavior. The econometric models to expose providers' and consumers' preferences in health care are estimated using classical maximum (simulated) likelihood (Chapters 2, 3, and 5) or modern Bayesian methods (Chapters 4 and 6).

Chapter 2 – What Do Physicians Dislike About Managed Care? Evidence from a Choice Experiment – deals with physicians' preferences for MC, which imposes restrictions on physician behavior but also holds promises, especially in terms of reducing cost and increasing treatment quality. This chapter reports on private-practice physicians' willingness to accept (WTA) different MC features such as: shared decision making, treatment guidelines, quality circles, critical incident reporting, restricting referrals to preferred providers, and acceptance of a mandate to prescribe generics if available. In August 2011, a web-based survey was addressed to members of the Swiss Medical Association (FMH) containing a discrete choice experiment (DCE). With the exception of shared decision making, the survey found that all attributes are associated with positive WTA values. On the basis of these findings, private health insurers must be able to achieve substantial savings in order to create sufficient incentives for Swiss physicians to participate voluntarily in MC.

Chapter 3 – How Much Compensation for Accepting Budgetary Responsibility? Stated Preferences of Swiss Physicians – measures the costs of implementing financial incentives for ambulatory care physicians. As long as conventional private practice remains an alternative, physicians are only willing to join physician networks and accept budgetary co-responsibility if they are compensated for additional financial risk. The results from a discrete choice experiment including 1,521 physicians in 2011 indicate that costs of introducing budgetary co-responsibility is likely to exceed potential savings.

Chapter 4 – Preferences for Health Insurance in Germany and the Netherlands: A Tale of Two Countries – turns from provider to consumer preferences. Using two DCEs, this chapter measures willingness to pay (WTP) for health insurance attributes in Germany and the Netherlands. Two research questions naturally arise. First, what are citizens' preferences with regard to specific health insurance contracts in the two countries? Second, how do the preferences differ between the two countries? While the two populations agree in their resistance against MC-type attributes, German respondents require much higher compensation for giving up free physician choice and accepting a physician list.

The following two chapters return to provider preferences but use drug claims data instead of experimental data. The data to analyze physicians' prescribing behavior contain information about single prescriptions and were merged with provider and consumer characteristics. The data was provided by a major Swiss health insurer.

Chapter 5 – Generic Substitution, Financial Interests, and Imperfect Agency – tests physicians' imperfect agency, derived from the fact that some Swiss jurisdictions allow them to dispense drugs on their own account while others do not. Estimating a model of physician drug choice, the findings indicate a significant positive association between physician dispensing and the use of generic drugs. While profit considerations affect drug choice and point to imperfect agency, generics are prescribed more often to patients with high copayments or low incomes.

Chapter 6 – Do Dispensing Physicians Optimize Their Own Drug Margins? Evidence from Switzerland – investigates how pharmaceutical pricing may set financial incentives for combined drug providers (dispensing physicians or prescribing pharmacists) to conduct margin optimization. As in Chapter 5, the empirical analysis is based on the co-existence of dispensing and non-dispensing physicians in Switzerland. Comparing logistic drug margins and drug costs between dispensing physicians and pharmacies reveals that dispensing physicians in fact achieve higher drug margins and produce higher drug costs through inefficient package choices.

Three chapters were written in cooperation with co-authors. Peter Zweifel co-authored Chapters 2, 4, and 5, while Maria Trottmann co-authored Chapter 5, and Karolin Leukert co-authored Chapter 4. Because each chapter of this dissertation can be considered as self-contained, all references across chapters are made explicit and the list of references appears at the end of this dissertation.

WHAT DO PHYSICIANS DISLIKE ABOUT MANAGED CARE? EVIDENCE FROM A CHOICE EXPERIMENT

BY

Maurus Rischatsch and Peter Zweifel

SUMMARY

Managed Care (MC) imposes restrictions on physician behavior but also holds promises, especially in terms of cost savings and improvements in treatment quality. This contribution reports on private-practice physicians' willingness to accept (WTA, compensation asked, respectively) for several MC features. In 2011, 1,088 Swiss ambulatory care physicians participated in a discrete choice experiment which permits to put WTA values on MC attributes. With the exception of shared decision making and up to six quality circle meetings per year, all attributes are associated with non-zero WTA values. Thus, health insurers must be able to achieve substantial savings in order to create sufficient incentives for Swiss physicians to participate voluntarily in MC plans.

Chapter 2

What Do Physicians Dislike About Managed Care? Evidence from a Choice Experiment

2.1 Introduction

Many governments try to limit the rise in health care expenditure by prescribing or encouraging Managed Care (MC) programs. In mixed systems permitting choice, consumer participation in MC can be encouraged by lowered contributions to health insurance [for evidence about the reduction required to induce voluntary participation by consumers, see e.g. Zweifel et al. (2006)]. However, health service providers must also be won over to MC to avoid quality problems, in particular due to a lack of participating physicians. For instance, expansion of MC plans in the United States has been hampered by difficulties in recruiting service providers. In Germany, the creation of so-called Integrated Care centers has been slow for the same reason. These difficulties are compounded in countries with a notable shortage of general practitioners (GPs), who play a crucial role in MC in acting as gatekeepers. In the case of Switzerland, only about 10 percent of medical students intend to become GPs, while retiring GPs have difficulties finding a successor for their practice [see Buddeberg-Fischer et al. (2006)].

Hence, health care reforms designed to foster MC need to address the issue of sufficient attractiveness of MC practice particularly to general practitioners.

Incentives for providers to participate in MC programs are mixed. On the one hand, they have to accept limitations on their professional autonomy, and possibly increased financial risk (especially if they participate in the financial success of the scheme). On the other hand, they can benefit from regular work hours, shared investment cost, and easier exchange of information within a network. The present paper purports to provide information about physicians' preferences, expressed in terms of the compensation sought (or willingness to accept, WTA) for departing from their conventional job characteristics without MC obligations. The evidence comes from a stated preference experiment of the discrete-choice type (DCE) performed with 1,088 Swiss private-practice physicians working in ambulatory care in 2011. While evidence based on actual behavior would be preferable in principle, market experiments can inform policy makers and health insurers about the chances of success of planned changes, helping them avoid costly failures.

This paper is organized as follows. Section 2.2 contains an overview of the existing literature on physicians' preferences, with special reference to evidence from DCEs. The theoretical background to understand DCEs and the methods to derive WTA values are given in Section 2.3. Section 2.4 outlines the study design and discusses the MC attributes of interest. Section 2.5 describes the data. The estimation results are discussed in Section 2.6 and conclusions are drawn in Section 2.9.

2.2 Literature review

The existing literature on physician behavior mainly revolves around the impacts of different reimbursement systems [see Labelle et al. (1994), Pauly (1994), and McGuire (2000) for an overview]. The precise nature of physician preferences usually is not addressed because they do not seem to affect predictions in a substantial way. Some authors have nevertheless posited particular preferences by including professional ethics, which in principle should motivate physicians to hail MC treatment concepts such as shared decision making (SDM) and critical incident reporting (CIR) [see Feldstein (1970), Zweifel (1981), Dionne and Contandriopoulos (1985)]. Attributes of professional activity originally received little attention, except for the rate of return associated with specialization [Sloan (1971)]. More recently, Gagne and Leger (2005) have examined the choice of specialty in Canada from 1976 to 1991 in response to changes in fee-for-service rates. They find income differences to be a significant factor. However, gender, mother tongue, medical school attended, state laws, and geographic conditions have a bearing on the choice of specialty as well. With the spread of MC, research into the determinants of choice of type of medical practice received new impetus. Hypothesized attributes are reputation and status [Enthoven (1978) and Richardson (1981)], properties of the medical practice [Beardow et al. (1993)], and intellectual satisfaction [Feldstein (1970), Enthoven (1978)]. Kristiansen (1994) has claimed professional autonomy to be an additional attribute that needs to be taken into consideration. However, the relevance of these attributes, especially the non-pecuniary ones, has been little investigated.

Against the background of undersupply in rural areas of Norway, Kristiansen (1992) analyzed the determinants of the decision where to locate. Place of birth, place of residency, and spouse's place of origin were found to be significant factors. However, they are not of overriding importance, causing the author to conclude that the problem of underprovision could be solved through the use of financial incentives. In addition, non-pecuniary motives might be enhanced in order to relieve the public budget, e.g. by favoring medical students with a rural background (who are particularly likely to settle there). The same conclusion is drawn by Benarroch and Hugh (2004), who investigate the migration of physicians in Canada. Urbanization has a significantly positive effect on migration, whereas distance between major cities of a province has a significantly negative effect. While this research is valuable for informing policy makers about what motivates physicians to opt for existing alternatives, it is silent about their choices with regard to alternatives that are being considered but not available yet. In this situation, surveys and market experiments can fill the gap.

The effects of non-pecuniary job characteristics on physicians' labor supply decisions have mainly been surveyed in the psychological and medical literature [Scott (1998)]. Buddeberg-Fischer and Klaghöfer (2003) examine career paths of 497 last-year medical students over a period of eight years in Switzerland. Respondents stated versatility of the field (96 percent), intensive patient contact (87 percent), positive experiences during their studies (86 percent), compatibility of work with family (83 percent), and possibilities of self-employment (61 percent) as determinants of their choice of specialty. In addition, male students exhibit a preference for specialties with a scientific orientation, whereas females, for settings with intensive patient contacts. With regard specifically to MC alternatives, Nordt (2003) finds that conflicts due to a changed perception of the physician's professional role put more strain on practitioners in solo than in group practice. Similarly, incompatibility of work and family may be more of a problem in solo practice (2.8 out of a maximum of 5 points) than in group practice (2.3 points, difference statistically not significant).

Market experiments of the discrete-choice type (see Section 2.4 below) have been performed by Scott (2001) to investigate the preferences of practitioners in the United Kingdom with regard to working hours, work load, time spent on administration per week, out-of-hours appointments, and use of guidelines. Performing a DCE as well, Ubach et al. (2003) report WTA values for an extra hour of and on being on call as extra day per month. Wordsworth et al. (2004) find differences between principal and so-called sessional GPs.[1] On the whole, the evidence is in accordance with the theoretical predictions by Marinoso and Jelovac (2003), who compare the performance of gatekeeping and traditional settings, emphasizing the importance of non-financial motives for the payment of GPs to create favorable incentives.

While this research is valuable for pointing to job attributes that may be particularly valued (or resisted) by physicians, it fails to inform about their attitudes with

[1] Principal GPs have ownerships in their practice, whereas sessional GPs are freelancers (mainly young females with childcare responsibilities) and employees of NHS boards (Scotland).

regard to non-marginal changes. However, the transition from conventional independent private-practices to contractual obligations with insurers constitutes such a non-marginal change. Policy makers considering increasing the market share of MC through regulation as currently discussed in Switzerland need to know how much it takes to win physicians over.

2.3 Methods

Based on random utility theory [Luce (1959), Manski (1977), McFadden (1981) and McFadden (2001)], discrete choice experiments (DCEs) are designed to allow individuals to express their preferences for non-marketed goods or goods which do not yet exist. The number of applications of DCEs to the valuation of healthcare programs has been increasing during the past few years [see Hole (2008), Ryan and Gerard (2003) and Scanlon et al. (1997)]. For a review of the literature on discrete choice experiments in health economics, see De Becker-Grob et al. (2010). In a DCE, individuals are given a hypothetical choice between many or just two (binary choice) commodities. From these choices, the importance (more precisely, the expected utility) of product characteristics can be inferred. Inclusion of a cost or price attribute allows determining the valuation of the remaining product attributes in terms of money. In the present context, the price attribute is an extra payment per insured and month. The fact that respondents have to weigh several attributes simultaneously makes biases that plague Contingent Valuation (where individuals are asked about their willingness to pay directly, holding all other attributes constant) less likely than in a DCE [see Ryan (2004)].

The first step of a DCE involves the definition of the attributes of the commodity and the levels assigned to them [Louviere et al. (2000), Ryan and Gerard (2003)]. Here, attributes of MC are chosen to describe the physicians' work situation (for more details, see Section 2.4). When comparing hypothetical alternative MC contracts, a rational subject will choose the alternative with the higher level of utility. The decision-making process in a DCE can be seen as a comparison of utilities $U_{ni} = V_{ni} + \varepsilon_{ni}$ and $U_{nj} =$

$V_{nj} + \varepsilon_{nj}$, where V_{ni} represents the deterministic indirect utility of individual n from alternative i and ε_{ni} denotes the pertaining unobserved error term. Thus, individual n chooses alternative i (MC) rather than alternative j (conventional practice) if (and only if) $U_{ni} > U_{nj}$ which implies $V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj}$ so that $P_{ni} = Pr(\varepsilon_{nj} - \varepsilon_{ni} < V_{ni} - V_{nj},\ \forall j \neq i)$. Therefore, the probability of choosing i rather than j implies that the error term is dominated by the systematic difference in utility.

In this study, physicians' preferences are estimated with the aid of a random-coefficient logit model (RCM) estimated by simulated maximum likelihood. The RCM has three important advantages over the standard logit model.[2] First, it allows for random taste variation across physicians. Second, the RCM model permits unrestricted substitution patterns.[3] And third, it allows for correlation of unobserved factors over time. The choice probabilities for the RCM are given by

$$P_{ni} = \int \prod_{t=1}^{T} \frac{e^{\beta' x_{nit}}}{\sum_{j=1}^{J} e^{\beta' x_{njt}}} f(\beta|\theta)\ d\beta, \qquad (2.1)$$

where the logit probability is called the mixed function and $f(\beta|\theta)$ the mixing distribution with distribution parameters θ [see Train (2003), Chapter 6]. Subscript n identifies the physician and i the MC alternative at choice situation t. Preference heterogeneity is reflected by the mixing distribution $f(\beta|\theta)$, which is usually assumed to be normal or log-normal. The log-normal distribution serves to model a strictly positive or negative preference, e.g. for the price attribute. However, in practice the log-normal distribution may cause problems for different reasons (see Section 2.6). Therefore, applied researchers often keep the price attribute fixed. The choice of adequate mixing distributions is important and discussed in Section 2.6.

The mixing distributions reflect unconditioned or population preferences. If no choices were observed, one would only know that the coefficients follow $f(\beta|\theta)$. In

[2] The RCM (or mixed logit) model is a generalization of the standard logit model. The RCM reduces to the standard model if density $f(\beta) = 1$ for $\beta = b$ and 0 for $\beta \neq b$. Further, the random-intercept logit model (RIM, also called random-effects model) treats the constant as normally distributed with all other coefficients kept fixed.

[3] This is irrelevant to this study, which is of the binary choice type.

contrast, observed choices allow to condition the distributions of β on the choices (y), permitting to derive conditional or physician-specific distributions $h(\beta|y_n, x_n, \theta)$ of β [see Train (2003), Chapter 11]. By the Bayes theorem,

$$h(\beta|y_n, x_n, \theta) = \frac{P(y_n|\beta, x_n) \cdot f(\beta|\theta)}{\int P(y_n|\beta, x_n) \cdot f(\beta|\theta) d\beta} \propto P(y_n|\beta, x_n) \cdot f(\beta|\theta), \tag{2.2}$$

where the denominator is the normalizing constant. $P(y_n|\beta, x_n)$ is the probability of physician's observed choice sequence y_n given β and the attribute levels of the chosen alternatives x_n. Hence, all quantities are known to derive $h(\beta|y_n, x_n, \theta)$ and to calculate moments of physician-specific coefficients. Means can be simulated as weighted averages $\bar{\beta} = \sum_r w^r \beta^r$, with $w^r = P(y_n|\beta^r, x_n) / \sum_r P(y_n|\beta^r, x_n)$ where β^r is a draw from $f(\beta|\theta)$.

2.4 Study design

In this section, we present attributes related to physicians' professional activity that distinguish MC from conventional practice. Specifically, we analyze preferences for different forms of treatment concepts, critical incident reporting, quality circles, preferred provider lists, and generic drug lists.

Attribute	**Attribute levels**
	No contractual obligation to adhere to any item below versus:
Treatment concepts	Shared decision making: yes/no (SDM, $\pm$), Guidelines: yes/no (GL, $\pm$)
Critical incident reporting	Mandatory anonymous reporting: yes/no (CIR, $\pm$)
Quality circles $^{a)}$	Mandatory meetings per year: 0/3/6/12 (QC, $\pm$)
Preferred provider list	Referrals only to listed providers: yes/no (PPL, $\pm$)
Generic drug list	Restricted to prescribe generics if available: yes/no (GEN, $\pm$)
Payment	Payment of CHF 0.00/0.50/1.00/1.50/2.00 per insured and month (PAY, $+$)

Note: $^{a)}$ quality circles are defined to last 1.5 hours per meeting. The signs after the abbreviations in parentheses indicate our expectations about physician preferences.

Table 2.1: Attributes and attribute levels in the DCE

The attribute 'treatment concepts' has two levels. First, shared decision making (SDM) requires that patients are more strongly involved in the decision making process concerning the choice of treatment. SDM is widely applied in practice (especially encouraged by MC networks) in Switzerland, at least compared to other countries [see Deveugele et al. (2002)]. It is recommended in the medical literature as a way to make the physician a more perfect agent of the patient. An additional benefit of SDM from the point of view of a risk-averse physician is to shift the burden of proof in a malpractice suit to the (now informed) patient; however, liability suits against physicians are extremely rare in Switzerland. The downside of SDM is a certain curtailment of professional autonomy. Therefore, the valuation of SDM can go either way (see Table 2.1). The second level is adherence to treatment guidelines (GL), to be developed by physicians and accepted by insurers. They define how to proceed in the case of certain medical interventions. Guidelines are typical of MC; they are little known in Switzerland. They entail a strong limitation of professional autonomy combined with extra administrative work. They do shift the burden of proof in a malpractice suit to the insurer or agency (health administration) issuing them. In view of the very low likelihood of this event, GL is expected to have a positive WTA (compensation required).

Critical incident reporting (CIR) obliges physicians to anonymously report critical incidents that happened in their practice. On the one hand, CIR calls for extra time and effort and may give rise to fears of being interpreted as a confession of malpractice. On the other hand, CIR holds the promise of quality improvement in the treatment provided. Hence, the valuation of CIR can go either way (see Table 2.1).

The third attribute is the obligation to attend so-called quality circles (QC), another feature of MC. In QC, physicians meet on a regular basis to discuss new treatments and interventions as well as experiences made. This benefit to participating physicians has to be balanced against the sacrifice of time. Interviews with physician networks indicated that many of their members like to participate in QC provided they take place during lunches and are accompanied by presentations by fellow members or specialists. On the whole, no clear prediction about the expected sign of WTA can be made.

The fourth attribute is preferred provider list (PPL), which restricts referrals to specialists and hospitals to providers selected by the MC organization. This restriction is expected to be undesired by most physicians. However, some of them may support PPL because they believe in the ability of the MC organization to identify providers offering high quality and/or high cost-efficiency.

Fifth, mandatory prescription of generic drugs if available (GEN) is imposed by most MC organizations in Switzerland. Physicians may perceive GEN a good instrument for tackling rising drug expenditure; on the other hand, it does restrict their choice of pharmaceutical treatment. Therefore, preferences could go either way.

The sixth attribute represents the price attribute in the DCE. It is measured as a payment (PAY) over and above current income per MC-insured person per month (IPM). To be in line with microeconomic theory, all physicians should positively value PAY.

Attribute	**Obligation**
You are to base treatment decisions on shared decision making	yes
You obligate yourself to anonymously report critical incidents	yes
Number of quality circles you agree to attend per year	6 (1.5 hours ea.)
You accept a preferred provider list for referrals	yes
You prescribe exclusively generics if available	no
You receive payment of	CHF 1.50 / IPM $^{a)}$
I am willing to sign the MC contract with these obligations	☐
I would like to remain independent without obligations	☐

Note: $^{a)}$ payment is in CHF per insured per month (IPM). 1 CHF ≈ 1.1 USD at 2011 exchange rates.

Table 2.2: Example of choice scenario

An example of a choice scenario is shown Table 2.2. 'Independent without obligations' defines the status quo of conventional practice, an option available to all Swiss physicians. In fact, only 13 percent of respondents report to be in MC practice (see Section 2.5).

In Equation (2.3) below, the attribute levels for treatment concepts (SDM, GL), critical incident reporting (CIR), preferred provider list (PPL), and generic drug list

(GEN) are coded as dummy variables. Because SDM and GL are levels of one attribute, they never appear together in an alternative. Quality circles (QC) have levels of zero, three, six, and twelve (meetings per year). Coding them as three categorical variables (QC3, QC6, and QC12) has the advantage of not imposing a specific functional form such as the linear or quadratic. Finally, PAY denotes the payment a physician receives in return for accepting MC-type obligations, ranging from zero to CHF 2.00 per insured and month (IPM). With an enrolment of 600 (say), this maximum corresponds to about 8 percent of median monthly income [Künzi et al. (2011)]. Therefore, the deterministic part of the random utility can be written as

$$\begin{aligned} \beta' x \;=\; & \beta_1 \mathrm{SDM} + \beta_2 \mathrm{GL} + \beta_3 \mathrm{CIR} + \beta_4 \mathrm{QC3} + \beta_5 \mathrm{QC6} + \beta_6 \mathrm{QC12} \\ & + \beta_7 \mathrm{PPL} + \beta_8 \mathrm{GEN} + \beta_9 \mathrm{PAY} + \beta_{10} \mathrm{CONST}, \end{aligned} \tag{2.3}$$

where the β's are the taste parameters of interest to be estimated.

The total of six attributes and their levels combine to form 480 possible combinations of alternative MC contracts. Using JMP to optimize the experimental design, this number was reduced to 40 D-optimal choice scenarios and randomly split into four groups, resulting in 10 choice situations per respondent. Each of the 10 hypothetical MC contracts had to be evaluated against the reference case with no obligations imposed.

2.5 Data

The Swiss Medical Association (FMH) supported to carry out the discrete choice experiment (DCE) by including a link to the web-survey in a newsletter addressed to all members in private practice. In July 2011, a pretest involved a randomly selected sample of 1,000 FMH members. Respondents had the opportunity of writing comments, which indicated a good understanding of the survey. The main survey was fielded in August 2011 with a return rate of 11 percent, resulting in 10,461 observed choices by 1,088 physicians. A high share of 87 percent completed all ten choice scenarios, with 9.6 the average number of choices made per respondent. The share of respondents always choosing no obligations is 29 percent while 1 percent of physicians agreed to sign up to all MC alternatives presented. In addition to the DCE, the survey included questions about general attitudes concerning experience with MC, education, and other demographic variables.

			Percentiles		
Variable	MN	SD	5^{th}	MD	95^{th}
Age of physician	53.73	8.25	40.00	54.00	66.00
Job experience (in years)	26.00	9.74	11.00	27.00	39.00
Male respondents	0.81	0.39	0.00	1.00	1.00
Married	0.77	0.42	0.00	1.00	1.00
Number of children under 18	1.65	1.70	0.00	2.00	4.00
Urban practices	0.52	0.50	0.00	1.00	1.00
Suburban practices	0.24	0.43	0.00	0.00	1.00
Rural practices	0.23	0.42	0.00	0.00	1.00
General practitioners	0.45	0.50	0.00	0.00	1.00
Specialists without surgery	0.13	0.33	0.00	0.00	1.00
Specialists with surgery	0.13	0.33	0.00	0.00	1.00
Psychiatrists	0.16	0.37	0.00	0.00	1.00

Note: General practitioners include gynecologists and pediatrics. Statistics are mean (MN), standard deviation (SD), and median (MD).

Table 2.3: Respondent descriptives, Swiss ambulatory care physicians (2011)

The statistics compiled in Table 2.3 indicate that average age is a high 54 years [the same as the national figure, see Kraft (2010)]. With 26 years of experience, participants are somewhat past their halftime in independent practice on average. Accounting for 19 percent of the sample, women are underrepresented in the sample compared to their overall share of 32 percent in the medical profession stated by Kraft (2010). About 77 percent of sampled physicians are married (5 percent are single, 9 divorced) and have on average 1.65 children under 18 years. Some 52 percent have their practice in an urban environment, while 25 percent are located in suburban and 23 percent in rural areas, respectively. The majority of respondents are from the German-speaking northern and eastern parts of Switzerland (73 percent) while 24 percent are from the French-speaking western and the remaining 3 percent from the Italian-speaking southern parts.

Approximately 45 percent of sampled physicians are general practitioners (including gynecologists and pediatricians) while 13 percent are specialists without surgical and 13 percent with surgical activity. Psychiatrists constitute 16 percent of the sample, while the remainder declared themselves to belong to other groups or failed to state their specialty. Most respondents work in single practice on their own account (51 percent) or in shared practice on their own account (30 percent, not shown in Table 2.3). Shared practices with a common account are rare (5 percent). The MC setting is predominantly characterized by networks where members continue to work on their own account (12 percent of respondents); common-account networks are the exception (1 percent). Among physicians in shared practice, 61 percent work in a team of two, 24 percent in a team of three, and 8 percent in a team of four physicians. Maximum team size reported is a low nine physicians.

In the attitudinal part of the survey, participants were asked about their experiences with MC. This information is used in Subsection 2.7 to explore experience-related differences in WTA values with respect to MC attributes. Concerning treatment concepts, 57 percent have experience with shared decision making and 51 percent with treatment guidelines. About 27 percent of sampled physicians collected experience with critical incident reporting. Quality circles are the most prominent MC feature, with 60 percent of physicians having attended meetings at least once. As to the most restrictive MC features, only 14 percent stated experience with preferred provider lists and 27 percent with generic drug lists.

2.6 Estimation results

Table 2.4 shows the estimated distribution parameters for two different model specifications. Both are estimated by simulated maximum likelihood using 500 Halton draws [see Hole (2007)]. The left panel of Table 2.4 pertains to the random-intercept model (RIM) specification, where all coefficients are kept fixed with the exception of the constant, for which a normal distribution is assumed. The constant captures unobserved physician-specific effects. The right panel displays the parameters pertaining to the random-coefficient model (RCM), where all coefficients are assumed to be normally distributed (reflecting the theoretical expectations listed in Table 2.1), with the exception of a fixed coefficient for PAY. Revelt and Train (1999) give three reasons for keeping the price attribute fixed. First, it facilitates the calculation of population WTA values. Second, RCM estimates tend to be unstable when all coefficients are random [see Ruud (1996)]. Third, the appropriate choice of mixing distribution for the price attribute is not straightforward. The most frequently applied log-normal distribution does often not convergence in practice. Further, it renders estimates of the price coefficient that are very close to zero, causing implausible high WTA values [see e.g. Sillano and Ortuzar (2005)]. Therefore, the WTA values (see Figure 2.1 of Section 2.6.2) capture only preference heterogeneity from the MC attributes but no heterogeneity with respect to PAY and hence marginal utility of income [which may be substantial in view of the dispersion of medical income documented by Künzi et al. (2011)].

The simulated log-likelihood (SLL) values at convergence are -4,549.7 (RIM) and -4,261.0 (RCM) while the AIC are 9,121.3 (RIM) and 8,559.9 (RCM), respectively. Therefore, goodness of fit speaks in favor of RCM estimates, which are emphasized in the discussion below. Table 2.4 shows estimated mean and standard deviation parameters along with their standard errors (S.E.). The mean parameters are insignificant for CIR (RIM) and six meetings per year for both specifications. All remaining parameters are highly significant with a p-value below 0.01.

2.6.1 Share of physicians who dislike MC

The estimated parameters for the population distributions can be used to calculate population shares of physicians with negative preferences for MC. For attribute k, this share is given by $P(\beta_k < 0) = \Phi(-\mathrm{MN}_k/\mathrm{SD}_k)$, where Φ is the cumulative normal distribution and MN_k and SD_k are the estimated mean and standard deviation, as given in Table 2.4. An alternative approach is to calculate the share of negative physician-specific coefficients using Equation (2.2), which has the advantage of conditioning on

		Random-intercept model (RIM)		**Random-coefficient model (RCM)**	
Attribute	Parameter	Value	S.E.	Value	S.E.
Shared decision making	Mean	0.38	(0.07)	0.48	(0.09)
(SDM)	Standard deviation			0.95	(0.16)
Guidelines	Mean	-0.66	(0.09)	-1.49	(0.19)
(GL)	Standard deviation			2.43	(0.26)
Critical incident reporting	Mean	-0.06	(0.06)	-0.16	(0.09)
(CIR)	Standard deviation			0.31	(0.16)
Three quality circles	Mean	0.33	(0.09)	0.30	(0.11)
(QC3)	Standard deviation			0.10	(0.22)
Six quality circles	Mean	0.04	(0.09)	0.10	(0.11)
(QC6)	Standard deviation			0.79	(0.18)
Twelve quality circles	Mean	-0.91	(0.10)	-1.66	(0.18)
(QC12)	Standard deviation			2.09	(0.20)
Preferred provider list	Mean	-1.42	(0.07)	-2.28	(0.13)
(PPL)	Standard deviation			1.95	(0.14)
Generic drug list	Mean	-0.89	(0.07)	-1.66	(0.12)
(GEN)	Standard deviation			2.09	(0.15)
Payment [a)]	Mean	0.37	(0.05)	0.49	(0.06)
(PAY)	Standard deviation				
Constant	Mean	-0.73	(0.13)	-0.64	(0.16)
(CONST)	Standard deviation	1.79	(0.07)	1.86	(0.11)

Note: Number of physicians: 1,088; number of choices observed: 10,461. Coefficients for RCM are all assumed to be normally distributed, with the exception of a fixed coefficient for PAY.

Table 2.4: Preferences for Managed Care attributes – regression results

individual choices observed. Therefore, the conditioned shares are discussed below, while the unconditioned shares are shown in parentheses.

Regarding MC-type treatment concepts, only 9 (31) percent of physicians have a distaste for shared decision making while no less than 86 (73) percent dislike guidelines. Similarly, the share of physicians opposing critical incident reporting attains 93 (70) percent. Almost all physicians (1 percent rejecting) like to attend three quality circles per year. However, acceptance already decreases for six meetings per year, with 38 (45) percent against. Finally, a full 92 (79) percent dislike to be obliged to participate in twelve meetings per year. In sum, about one-half of sampled physicians are willing to participate in up to six quality circles without being compensated. The MC attribute with the highest share of opposing physicians is the preferred provider list with 94 (88) percent. Restricting drug prescriptions to generics if available is still refused by 88 (79) percent. These findings suggest that with the exception of shared decision making and up to six quality circle meetings per year, all MC-type attributes have to be compensated if a majority of Swiss physicians were to be won over to MC.

2.6.2 Willingness to accept MC-type obligations

Next, we focus on the physician-specific willingness-to-accept (WTA) values for MC attributes, shown in Table 2.5. The discussion concentrates on the median values from the RCM because they are more robust to outliers than the mean values.

		RIM	**RCM**			
					Percentiles	
Attribute	Abbrev.	MN	MN	MD	5^{th}	95^{th}
Shared decision making	SDM	-1.03	-1.00	-0.86	-2.56	0.31
Guidelines	GL	1.80	3.05	3.57	-2.31	6.53
Critical incident reporting	CIR	0.17	0.33	0.34	-0.10	0.66
Three quality circles	QC3	-0.89	-0.61	-0.61	-0.73	-0.50
Six quality circles	QC6	-0.11	-0.21	-0.17	-1.53	0.90
Twelve quality circles	QC12	2.46	3.46	3.71	-0.83	6.67
Preferred provider list	PPL	3.87	4.70	5.27	-0.18	8.15
Generic drug list	GEN	2.43	3.53	4.06	-1.54	7.40

Note: WTA values are shown in CHF per insured and month (CHF/IPM). 1 CHF ≈ 1.1 USD as of 2011.

Table 2.5: Willingness to accept MC-type obligations

The negative WTA value for SDM indicates that the median Swiss physician need not to be compensated for involving patients in the decision making about choice of treatment. In contrast, following guidelines has to be compensated with about 3.57 CHF per MC-insured per month (CHF/IPM). Critical incident reporting was shown to have a small, insignificant effect on the choice probabilities (Table 2.4). This is reflected by a WTA value of only 0.34 CHF/IPM; this low value likely reflects physicians' belief

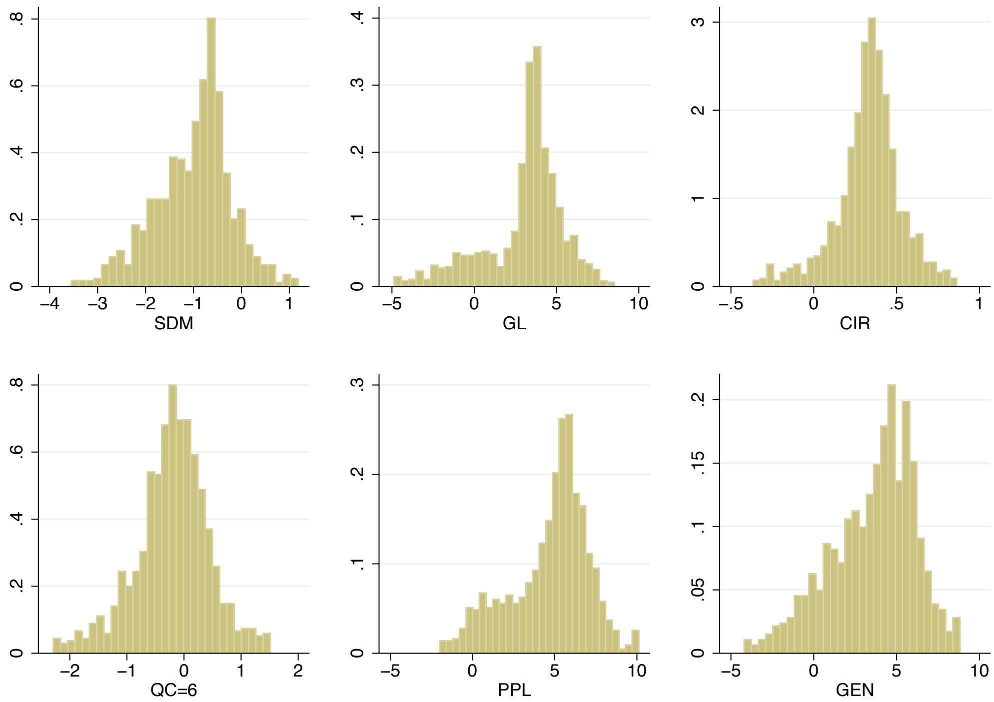

Figure 2.1: Histograms of physician-specific WTA values

that CIR contributes to an increase in treatment quality. Quality circles are positively valued up to six meetings per year by the median respondent; however, twelve meetings have to be compensated at the tune of 3.71 CHF/IPM. Restricting referrals to providers listed by insurers is strongly opposed and requires the highest compensation of all MC-type attributes. Its median WTA is 5.27 CHF/IPM. The next-highest WTA value pertains to the restriction to prescribe only generics if available (GEN), with 4.06 CHF/IPM. A likely reason for this high figure is the fact that about one-half of Swiss physicians live in jurisdictions permitting them to dispense drugs on their own account [Rischatsch et al. (2010)]. Therefore, the GEN attribute entails the loss of an option to generate extra income for many respondents.

In view of the entries of Table 2.5, the question arises of whether current extra payments by insurers suffice to win physicians over to MC. A typical value is 1.50 CHF/IPM for participating in a Health Maintenance Organization (HMO), the most restrictive MC variant (preferred provider organizations and gatekeeping networks, also exist in Switzerland). Clearly, this extra payment falls far short of what it takes to make the median Swiss physician join an HMO. To the extent that it reflects achievable cost savings due to MC, these savings could easily be insufficient for MC to increase its current market share.

Because the coefficient of PAY is kept fixed, the WTA values have the same distributions as the random coefficients for the MC attributes. The histograms of Figure 2.1 point to substantial heterogeneity of preferences especially with regard to GL, PPL, and GEN. Opinions appear to be strongly divided concerning GL and GEN in particular, where bi-modality is evident. In the case of GEN, this likely reflects the divide between physicians who dispense drugs on their own account and those who do not.

2.7 Effects of prior experience

The preference patterns and WTA values found in the previous section do not distinguish between different groups of physicians. This section is devoted to the question of whether prior experience with a MC setting makes a difference; differences between general practitioners and specialists are discussed in the next section.

To test for differences between physicians with and without MC experience, all attributes are interacted with a dummy indicating whether respondents stated to have made experience with this specific MC attribute. Table 2.8 of the Appendix (left-hand side) shows the estimated distribution parameters for the RCM containing this type of interaction. The physician-specific WTA values estimated for physicians with and without experience with the pertinent MC attribute are displayed in Table 2.6. In general, physicians with experience have lower WTA values, indicating less resistance against or even a preference for the MC feature. There are two reasons for this effect. First, physicians may like MC due to their favorable experience. Second, however, self-selection may be at work. Physicians with a preference for MC are likely to have selected this setting, causing them to have prior MC experience. As will be argued below, disentangling the two directions of causality in not worthwhile in the present policy context.

	Physicians without experience				**Physicians with experience**			
			Percentiles				Percentiles	
Attribute	MN	MD	5^{th}	95^{th}	MN	MD	5^{th}	95^{th}
Shared decision making	0.52	0.72	-1.40	2.25	-2.28	-2.09	-4.44	-0.40
Guidelines	3.80	3.85	1.46	5.55	0.89	1.22	-2.55	3.19
Critical incident reporting	0.72	0.75	0.13	1.20	-0.35	-0.34	-1.54	0.90
Three quality circles	0.37	0.37	0.30	0.44	-1.32	-1.32	-1.59	-1.04
Six quality circles	1.59	1.59	1.54	1.62	-1.39	-1.39	-1.44	-1.33
Twelve quality circles	5.08	5.18	1.95	7.45	2.95	3.05	-1.41	6.57
Preferred provider list	5.61	6.30	-0.37	9.38	2.78	2.98	-2.94	7.46
Generic drug list	4.64	5.52	-2.18	9.15	3.48	3.72	-2.24	8.69

Note: WTA values are shown in CHF per insured per month, IPM using physician-specific WTA values from RCM, containing interactions. 'Experience' refers to the particular MC attributes listed.

Table 2.6: Willingness-to-accept values by experience

The discussion is limited to the most salient differences. They concern SDM, PPL, and GEN. First, physicians who stated that they never made experience with SDM dislike to involve patients in the decision making process. They ask for a median compensation of 0.72 CHF/IPM for SDM. In contrast, physicians with experience in SDM have a positive preference for it and do not have to be compensated. Second, physicians who have worked with a preferred provider list (PPL) exhibit a median WTA value of 2.98 CHF/IPM, less than one-half of that characterizing their colleagues without that experience (6.30 CHF/IPM). Third, restricting drug prescription to generics has a median WTA of 3.72 CHF/IPM among physicians who have applied such a list, compared to 5.52 CHF/IPM for those who have not.

While it would be of scientific interest to distinguish the effect of prior experience from a possible self-selection effect, for policy makers attempting to increase the market share of MC, this is a moot point. They need to win over physicians without prior MC experience. This means that the achievable cost savings must suffice to finance the higher compensations asked by this group – letting alone the compensation asked by Swiss consumers as estimated by another DCE [Zweifel et al. (2006)].

2.8 Differences between GPs and specialists

In the survey, physicians were asked to state if they are general practitioners (GPs, including gynecologists and pediatricians), specialists with and without surgical activities, or psychiatrists. Because GPs play a crucial role in MC as gatekeepers for their patients, this section compares their preferences with those of their specialized colleagues who are grouped together as 'specialists'. The same RCM is estimated as in Section 2.6, but this time with MC attributes interacted with a dummy variable indicating whether the respondent is a specialist or not. In analogy to the previous section, estimated distribution parameters are relegated to Table 2.8 of the Appendix (right-hand side). Table 2.7 displays the calculated physician-specific WTA values.

	General practitioners				**Specialists**			
			Percentiles				Percentiles	
Attribute	MN	MD	5^{th}	95^{th}	MN	MD	5^{th}	95^{th}
Shared decision making	-0.58	-0.55	-1.62	0.46	-1.03	-0.70	-4.37	1.07
Guidelines	3.38	4.26	-3.34	7.63	3.47	4.15	-3.15	7.15
Critical incident reporting	0.23	0.24	-0.16	0.59	0.68	0.78	-0.59	1.46
Three quality circles	-0.90	-0.90	-0.96	-0.85	-0.13	-0.12	-0.56	0.27
Six quality circles	-0.98	-0.98	-1.32	-0.64	0.60	0.60	0.20	0.96
Twelve quality circles	2.50	2.49	-0.12	4.92	3.61	3.72	0.93	5.83
Preferred provider list	3.64	3.64	-0.11	6.91	5.94	6.53	-1.30	11.30
Generic drug list	2.93	3.06	-1.70	6.80	4.15	4.44	-0.84	7.55

Note: WTA values are shown in CHF per insured per month, IPM using physician-specific WTA values from interacted RCM.

Table 2.7: Willingness-to-accept values, general practitioners vs. specialists

With regard to most MC-type attributes, WTA values do not markedly differ between GPs and specialists. There are two exceptions. One is the preferred provider list (PPL), for which the median GP would have to be compensated at the tune of 3.64

CHF/IPM, compared to 6.53 CHF/IPM for the median specialist, the overall maximum found in this study. This discrepancy is intuitive for three reasons. First, a specialist who joins a MC network depends on referrals from GPs (potentially governed by a PPL) in an even more decisive way than in conventional practice, whereas referrals play a minor role in either setting for a GP. Second, many specialists serve more than one MC network, in which case a PPL imposed by one of the networks can hurt them. By way of contrast, GPs typically work for a single MC organization; there is no need for them to rely on demand emanating from other MC organizations. Finally, specialized physicians may feel that they know better than GPs which providers to choose for their patients or networks. The second discrepancy concerns the generic drug list (GEN), where GPs have to be compensated with a median of 3.06 CHF/IPM, but specialists with 4.44 CHF/IPM. A likely explanation is that specialists are more likely than GPs to treat rare diseases that might call for a brand-name drug, which is not listed.

On the whole, general practitioners are found to be less strongly opposed to attributes of MC. Thus, winning them over to MC is less costly than estimated in Section 2.6 based on the whole sample. Still, a payment of 1.50 CHF/IPM remains insufficient for attracting a majority of GPs to a MC organization that imposes guidelines more than six quality circle meetings per year, a preferred provider list, or a generic drug list.

2.9 Conclusions

Policy makers try to limit increasing health care expenditure by mandating or encouraging Managed Care (MC). However, attempts to increase the market share of MC often fail due to a lack of participating physicians. As long as conventional practice remains an alternative, health service providers must be won over to MC because they have to accept limitations of their professional autonomy. The objective of this contribution is to investigate physicians' preferences for MC attributes measured as willingness-to-accept (WTA) values. The data come from a sample of 1,088 Swiss private-practice physicians working in ambulatory care participating in a discrete choice experiment (DCE) in 2011.

The MC attributes studied are shared decision making and guidelines, reflecting treatment concepts, critical incident reporting, attending zero, three, six, or twelve quality circle meetings per year, accepting a preferred provider list, and having drug prescription restricted to generics if available. To determine the money valuation of MC attributes expressed as WTA values, a price attribute is included, defined as a payment per MC-insured per month (IPM) to compensate the physician for additional cost and effort.

Estimated distribution parameters for the random-coefficient model show that the median Swiss physician likes shared decision making, three quality circles, and payment, is indifferent with regard to six quality circles per year, and dislikes all other MC attributes. The highest share of opposing physicians is found for the preferred provider list. All respondents like three quality circles per year. With respect to strength of opposition, estimated WTA values reveal that preferred provider and generic drug lists have to be compensated most, with median WTA ranging from 3.60 CHF/IPM to 5.30 CHF/IPM (1 CHF $\approx$ 1.1 USD in 2011). These figures exceed current level of 1.50 CHF/IPM, which already amounts to 8 percent of median physician income. Shared decision making and up to six quality circles are accepted without compensation.

Clear signs of preference heterogeneity motivate distinctions between physician groups. For an expansion of MC, physicians without prior experience with MC-type attributes need to be attracted. However, some of their WTA values turn out to be twice as high as those of physicians with prior experience. Another distinction of importance is between general practitioners and specialists since some MC organizations have difficulty offering the full range of specialties. Indeed, specialists are found to exhibit higher WTA values than GPs almost without exception; their resistance against a preferred provider list would have to be overcome by a payment of 6.53 CHF/IPM, the overall maximum found in this study. Considering that a current rate for participating in an

HMO is 1.50 CHF/IPM, these findings lead to the prediction that MC plans designed to achieve cost savings will never enlist the majority of Swiss physicians as long as they retain the option of conventional practice with full professional autonomy. Realistically, the implementation of shared decision making, critical incident reporting, and up to six quality circle meetings per year can be expected. It is doubtful that future cost savings achievable through treatment guidelines, preferred provider list and generic drug lists are of a magnitude that would permit the current 1.50 CHF/IPM to be doubled or even tripled, reaching compensation amounts that would render MC attractive to the median physician. Prospects for a voluntarily, market-driven expansion of MC in Switzerland look rather bleak indeed.

Acknowledgement

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Appendix

		Experience		Profession	
Attribute	Parameter	Value	S.E.	Value	S.E.
Shared decision making	Mean	-0.24	(0.14)	0.28	(0.11)
	Standard deviation	1.14	(0.16)	0.71	(0.16)
SDM interacted	Mean	1.32	(0.17)	0.18	(0.18)
	Standard deviation	0.35	(0.96)	1.30	(0.27)
Guidelines	Mean	-1.71	(0.22)	-1.55	(0.24)
	Standard deviation	1.30	(0.32)	2.65	(0.26)
GL interacted	Mean	1.25	(0.26)	-0.07	(0.31)
	Standard deviation	0.91	(0.38)	0.79	(0.34)
Critical incident reporting	Mean	-0.34	(0.10)	-0.11	(0.11)
	Standard deviation	0.37	(0.17)	0.34	(0.24)
CIR interacted	Mean	0.54	(0.18)	-0.22	(0.17)
	Standard deviation	0.72	(0.28)	0.61	(0.26)
Preferred provider list	Mean	-2.50	(0.14)	-1.62	(0.13)
	Standard deviation	2.22	(0.18)	1.49	(0.20)
PPL interacted	Mean	1.07	(0.31)	-0.95	(0.21)
	Standard deviation	0.36	(0.43)	2.09	(0.22)
Generic drug list	Mean	-2.10	(0.19)	-1.31	(0.14)
	Standard deviation	2.48	(0.24)	1.71	(0.14)
GEN interacted	Mean	0.41	(0.23)	-0.56	(0.20)
	Standard deviation	0.41	(0.29)	0.65	(0.17)
Three quality circles	Mean	-0.17	(0.16)	0.42	(0.13)
	Standard deviation	0.04	(0.29)	0.04	(0.20)
QC3 interacted	Mean	0.78	(0.18)	-0.37	(0.17)
	Standard deviation	0.15	(0.19)	0.31	(0.29)
Six quality circles	Mean	-0.73	(0.17)	0.46	(0.14)
	Standard deviation	0.03	(0.23)	0.23	(0.27)
QC6 interacted	Mean	1.37	(0.19)	-0.75	(0.19)
	Standard deviation	0.01	(0.24)	0.10	(0.24)
Twelve quality circles	Mean	-2.33	(0.25)	-1.15	(0.18)
	Standard deviation	1.45	(0.25)	1.26	(0.24)
QC12 interacted	Mean	0.94	(0.27)	-0.49	(0.23)
	Standard deviation	1.24	(0.34)	0.59	(0.25)
Constant	Mean	-0.56	(0.16)	-0.42	(0.15)
	Standard deviation	1.76	(0.11)	1.77	(0.09)
Payment	Mean	0.46	(0.06)	0.47	(0.06)

Table 2.8: Preferences for Managed Care attributes (model with interactions)

HOW MUCH COMPENSATION FOR ACCEPTING BUDGETARY RESPONSIBILITY? STATED PREFERENCES OF SWISS PHYSICIANS

BY
Maurus Rischatsch

SUMMARY

Managed Care (MC) is expected to provide health care at lower cost than conventional health care provision. Switzerland intends to promote MC by two major changes in regulation. First, the government should be allowed to force insurers to write MC contracts. Secondly, the introduction of budgetary co-responsibility for ambulatory care physicians is intended. On the one hand, the obligation of writing MC contracts asks for additional physicians working in networks or Health Maintenance Organizations (HMOs). On the other hand, as long as conventional practice remains an alternative, physicians are likely to oppose network participation due to budgetary co-responsibility. The success of the reform depends on the ability to win enough physicians over to join networks. Therefore, this study analyzes preferences of Swiss ambulatory care physicians for payment attributes. Results from a discrete choice experiment conducted in 2011 including 1,521 physicians show that the compensation for accepting budgetary co-responsibility is likely to exceed insurer's potential cost savings. This leads to the conclusion that the discussed reform is likely to fail to increase the market share of Managed Care.

Chapter 3

How Much Compensation for Accepting Budgetary Responsibility? Stated Preferences of Swiss Physicians

3.1 Introduction and motivation

Health care expenditure in Switzerland is among the highest in the OECD countries and rises at a faster rate than its gross domestic product (GDP). Statistics from the OECD (2010a) show that only the United States and France have higher spending per capita as well as higher shares of GDP. As a consequence, health insurance premiums have steadily increased over the last decade encouraging the debate on possible health care reforms.

While Managed Care (MC) is the dominant form of health insurance in the United States, MC is less established in Europe. In 1990, Switzerland was the first European country to allow MC contracts in its social health insurance [Beck et al. (2009)]. Twenty years later, the promotion of MC is still at the top of the political agenda. Currently, the Swiss parliament debates a reform with the objective to increase its market share through new regulations, as several studies have shown that MC contributes to lower health care expenditure and to an increase in treatment quality [compare Berchtold and Hess (2006) and Beck et al. (2009) again]. Two major changes in regulation are discussed. First, the reform intends to allow the government to force health insurers to write MC contracts without granting them the authority to establish their own MC organizations or to invest in such organizations. Therefore, insurers have to contract with independent physician networks or Health Maintenance Organizations (HMOs) who currently insure about 12.5 percent of Swiss citizens. Second, budgetary co-responsibility should be introduced for ambulatory care physicians who are currently remunerated through fee-for-service (FFS). According to Robinson (2001), FFS '[...] rewards inappropriate services, the fraudulent upcoding of visits and procedures, and the churning ping-pong referrals among specialists [...]'. However, the introduction of budgetary co-responsibility, which uses capitation for the calculation of spending targets, may '[...] reward the denial of appropriate services, the dumping of the chronically ill, and a narrow scope of practice that refers out every time-consuming patient [...]'. Thus, introducing cost sharing to fight increasing health care expenditure comes at a price.

In Switzerland, independent private practice physicians are mainly responsible for providing ambulatory care. About 50 percent of all general practitioners (GPs) and more than 400 specialists cooperated with one of 86 established networks or HMOs in 2010 [see Berchtold and Peytremann-Bridevaux (2010)]. However, increasing the share of MC-insured citizens requires the recruitment of additional physicians working in MC organizations. Physicians working in HMOs are often employed and paid with a fixed salary. Therefore, it is unlikely that enough physicians are willing to give up their professional autonomy and join HMOs. In contrast, network physicians are often less integrated. They work under conventional FFS on their own account, but accept budgetary co-responsibility for a common spending target. Therefore, successful establishment of additional physician networks is more likely to be achieved than building up new HMOs. This might also be true for medical students entering the market.

Buddeberg-Fischer and Klaghöfer (2003) find that the possibility of self-employment is an important determinant for the choice of specialty for 61 percent of surveyed last-year medical students. Thus, the focus of the present study is on physician networks. Following the definition of Medswiss (2010), physician networks 'provide healthcare services geared to the requirements of the patients means of contractually agreed co-operation among themselves, with service providers outside the network and with the insurance companies'.

According to Berchtold and Peytremann-Bridevaux (2010), Swiss physician networks and HMOs were all established by initiatives of physicians and health insurers. Because the discussed health care reform does not grant the authority to insurers to establish their own MC organizations, new physician networks can only be established by third-party organizations. Insurers have to contract with these organizations, which on the other hand have to attract enough physicians for their networks. Because many physicians strongly oppose budgetary co-responsibility, voluntary network participation is expected to be low as long as physicians are not compensated for the financial risk. In sum, while the obligation to write MC contracts requires a high number of physicians working in networks, imposing budgetary co-responsibility distracts them from joining networks.

The objective of this paper is to elicit Swiss physicians' stated preferences for payment attributes and to establish if savings created through the introduction of budgetary co-responsibility potentially exceed the cost of implementing such an incentive system. Thus, willingness-to-accept (WTA) values for payment attributes used to design cost sharing are derived from the estimates of a discrete choice experiment, which was carried out in 2011 and includes 1,521 ambulatory care physicians. Comparing estimated implementation costs for incentives with potential benefits leads to the conclusion that the discussed reform is likely to fail to meet its objectives and that network participation cannot be achieved on voluntary basis as long as conventional practice remains an alternative.

The paper is organized as follows. Section 3.2 gives a short literature review of designing incentives to increase agent's performance in the principal-agent relationship. Section 3.3 discusses how budgetary co-responsibility can be modeled in payment mechanisms and describes how physician's financial risk aversion can be expressed in WTA values. Section 3.4 derives expected theoretical preferences for or against payment attributes. Section 3.5 discusses the design of the discrete choice experiment and explains how preferences are measured. Section 3.6 specifies physician's utility derived from alternative payment mechanisms and discusses the econometric model used to elicit preference weights. Section 3.7 describes the experimental data. Estimation results are interpreted in Section 3.8. The concluding Section 3.9 highlights policy implications.

3.2 Literature review

The existing economic literature on incentive pay mainly revolves around the impacts of differently designed incentive mechanisms to improve performance of employees [see Ichniowski and Shaw (2003) and Gibbons (1996) for an overview]. However, optimal designs may differ if one is interested in containing medical expenditure.

Burgess and Ratto (2003) analyze the importance of incentive pay to improve public-sector efficiency in the United Kingdom. They point out that the optimal design of incentives in the public sector may differ from those in the private sector. Not all mechanisms used in private firms, like piece rates, options, discretionary bonuses, promotions, profit sharing, efficiency wages, or deferred compensation, are necessarily optimal to provide incentives in the public sector, where employees are often multi-tasking and performance measurement is difficult [compare Prendergast (1999)]. Similar problems are present in the principal-agent relationship between health insurers and providers, where especially performance measurement is difficult because treatment quality does not only depend on provider's performance but also on unobserved patient characteristics. Burgess and Ratto (2003) conclude that 'team-based rewards may be preferred to individual compensation schemes, in contexts where cooperation is important for the outcome of the organization or where only aggregate measures of performance are available' speaking in favor of group-based budgetary co-responsibility for physicians. Moreover, they find that bonuses from better performance should be invested in a better working environment instead of paying individual bonuses in organizations where employees are strongly intrinsic motivated. Hence, instead of paying gain-sharing bonuses for achieved cost savings to individual physicians, insurers or networks could invest cost savings in e.g. new equipment.

Again, since the interests of health insurers and providers are not always aligned, designing optimal payment mechanisms to induce providers to practice in the insurer's interest has stimulated the literature on physician incentives. Introducing cost consciousness in health care is a special case of incentive designs that can arise whenever principals rely on the judgment of skilled agents to ration resources. Town et al. (2004) assess the influence of incentives on physicians and medical groups. They show that psychological and organizational factors influence incentive effects. Because we are interested in introducing cost consciousness through budgetary co-responsibility, we concentrate on financial incentives only. Gaynor et al. (2004) study how primary care physicians in MC networks respond to financial incentives to contain medical expenditure in the United States, where MC is the dominant form of health insurance. MC organizations rely on a system of financial and non-financial incentives that encourage physicians to control costs. They find that group-based incentives are more effective in reducing medical expenditure for small physician panels because many group-based incentives rely to some extent on the power of peer pressure to abolish moral hazard. In the present context, introducing budgetary co-responsibility on network level therefore requires an optimal choice of panel size.

In contrast to the studies cited above, this study is interested in how much the implementation of incentives costs. While Gaynor et al. (2004) estimate contained medical costs through incentives, they do not establish if created savings exceed the cost of implementation. The objective is to measure the asked compensation of physicians for accepting budgetary co-responsibility. The next section turns to incentive designs with respect to physician payment mechanisms.

3.3 Physician payment mechanisms

This section describes conventional and alternative physician payment mechanisms. It starts with modeling a payment system for a network including budgetary co-responsibility, which can be reduced to conventional fee-for-service, depending on the choice of payment parameters.

Considering a network including N physicians, network profit can be written as

$$\begin{aligned} \Pi &= (1-s)R + \Big[sR + b(T-C)\Big]\,\mathbb{1}(C \leq T) - \Big[m(C-T)\Big]\,\mathbb{1}(C > T) - C, \\ &\quad \text{with } R = (1+\mu)C \end{aligned} \tag{3.1}$$

where $\mathbb{1}(\cdot)$ is an indicator function being one if the expression in parenthesis is true and zero otherwise.[1] For simplicity, only one medical service is considered so that network's total costs are given by $C = \sum_{n=1}^{N_T} c_n$ where n indicates patients and c_n denotes patient's cost within a year. It is assumed that physicians can only influence c_n by choosing cost-efficient treatments but that they do not 'dump' patients so that total number of patients seen per year (N_T) is exogenous. To limit risk caused by patients with unexpectedly high c_n, a stop-loss provision limit L per patient per year is introduced so that in the case of $c_n > L$ only L contributes to C instead of actual c_n. Revenues are given by $R = (1+\mu)C$ with μ denoting a mark-up added to C to compensate physicians for delivering health care (income contribution). The spending target (T) (which is bargained ex ante between insurer and network) depends on the number of enrollees in the network (N_E) and expected average treatment cost across networks ($\tilde{c}$). The target level is determined by $T = \lambda w \tilde{c} N_E$, where w is a weighting

[1] In this study, we investigate physicians maximizing network's profit. Individual profit for each member is then given by the network-specific internal income allocation. Commonly, network members receive their own fee-for-service (FFS) claims and are participated in a gain/loss. How specific gains or losses are distributed among members is not discussed further in this study.

factor taking into account network-specific characteristics (e.g. specialization and skill mix), forecasts of changes in demand, and expected price changes. Factor λ defines intended cost reduction compared to non-MC insured.[2]

Gaynor et al. (2004) investigate an HMO payment mechanism where a certain share of fees is retained by the insurer until the end of the year (payment at risk) and only paid to the HMO if costs are below the spending target. Otherwise, the insurer keeps the retained fees. This type of incentive is represented in Equation (3.1) by parameter s. A bonus/malus contribution is more common in practice. The bonus can be defined in absolute or relative terms. Absolute values are more likely to be accepted by physicians because the limits of the gain-loss contribution are known ex ante. However, in this study different types of physicians with different cost structures are analyzed making the use of relative bonus and malus payments more appropriate. Thus, parameter b denotes the share of achieved cost savings that goes to the network as a gain-sharing bonus and m defines the share of cost above spending target that the network has to bear as a loss-sharing malus. Therefore, in addition to the income contribution through fee-for-service, a network is able to increase profit or decrease losses by using cost-effective treatments (gain-loss contribution).

Using Equation (3.1), we can define state-dependent profit to be Π_1 if costs are below spending target (state 1) and Π_2 in the case where costs exceed the spending target (state 2) with $C_1 < T < C_2$. In this case expected profit reads

$$E[\Pi] = \tau \Big[\mu C_1 + b(T - C_1) \Big] + (1-\tau) \Big[\mu C_2 - s(1+\mu)C_2 - m(C_2 - T) \Big], \qquad (3.2)$$

where τ denotes the probability that state 1 occurs. If no budget responsibility is introduced, i.e. $s = b = m = 0$, networks are reimbursed by conventional FFS and Equation (3.2) reduces to

$$E[\Pi^{\mathrm{FFS}}] = \tau[\mu C_1] + (1-\tau)[\mu C_2]. \qquad (3.3)$$

2 In reality, many different groups can be defined according to e.g. enrollee's age and gender. The spending target is then given by $T = \lambda w \sum_g \tilde{c}_g N_{E,g}$, with $\tilde{c}_g$ denoting group-specific average cost where groups are identified by $g = 1, ..., G$.

Next, one can single out the expected gain-loss contribution to profit and write expected profit as the sum of income and gain-loss contribution. Uncertainty caused by budgetary co-responsibility is reflected by $E[\Pi] = E[\Pi^{\mathrm{FFS}}] + E[\Pi^{\mathrm{PBR}}]$ with

$$E[\Pi^{\mathrm{PBR}}] = \tau\left[b(T - C_1)\right] + (1-\tau)\left[-s(1+\mu)C_2 - m(C_2 - T)\right]. \tag{3.4}$$

As seen from Equation (3.4), introducing budgetary responsibility increases uncertainty. Assuming risk averse physicians, a von Neumann-Morgenstern (VNM) utility function $\upsilon(\cdot)$ permits to compare certain with uncertain profits and to measure compensation asked to bear higher risk through budgetary co-responsibility. The VNM utility function can be written as

$$\upsilon(\Pi_0) = \upsilon(E[\Pi^{\mathrm{PBR}}] - \mathrm{WTP}), \tag{3.5}$$

where Π_0 denotes a certain profit. Physicians' willingness to pay (WTP) to avoid uncertainty can then be used to derive willingness to accept (WTA, denoted by ρ) budgetary responsibility [compare Zweifel and Eisen (2011), Chapter 2]. Therefore, ρ serves as the price attribute in the discrete choice experiment (DCE) to measure risk compensations for introducing budgetary co-responsibility. Physicians' participation in networks is commonly reimbursed through a payment per network-insured per month. The price attribute used in the DCE outlined in Section 3.5 is therefore defined to be a payment per insured per month (IPM).

3.3.1 Conventional reimbursement of independent practices

In Switzerland, independent private-practice physicians are paid according to a fee-for-service (FFS) schedule. Therefore, FFS constitutes the reference payment system for the no-network option in the DCE (see Section 3.5) because it does not include budget co-responsibility. The profit function given by Equation (3.1) reduces to $\Pi = \mu C$ because $s = b = m = 0$ and $N = 1$ with no spending target nor stop-loss provision. Thus, physicians may be incentivized to provide expensive medical services resulting in high c_n and/or try to treat more patients than necessary so that N_T rises. The latter constitutes the classical supplier-induced demand [see McGuire (2000)]. Therefore, alternative payment systems including budgetary co-responsibility are of great interest for insurers to help contain medical costs.

3.3.2 Payment mechanisms with budgetary co-responsibility

Budget co-responsibility can be modeled in different ways. A first example is described and analyzed by Gaynor et al. (2004). This payment system can be modeled using Equation (3.1) where $s > 0$, $b > 0$, $m = 0$, and $\mu > 0$. Network profit is then given by

$$\Pi = (1 - s)R + [sR + b(T - C)]\, \mathbb{1}(C \leq T) - C$$

with $R = (1 + \mu)F$ and a spending target which is derived as discussed above.[3] The stop-loss provision is limited at USD 15,000 per patient per year and revenues are calculated based on Medicare's fee schedule (denoted by F instead of cost C). Bonuses are based on the performance of panels of doctors which vary between three and 30 physicians. Realized cost savings $(T - C)$ are divided in equal shares between insurer and network. If costs exceed the spending target, network loss amounts to the retained revenues.

A second example imposes budgetary co-responsibility through a bonus combined with a malus instead of a bonus and retained revenues. The gain-sharing bonus is often designed to be more generous than the loss-sharing malus, i.e. $0 < m < b < 1$. The reason is that insurers are better able to manage risks than networks. Services are paid through FFS (income contribution) where revenues are $R = (1 + \mu)C$. With this specification, Equation (3.1) reduces to

$$\Pi = \mu C + b(T - C)\mathbb{1}(C \leq T) - m(C - T)\mathbb{1}(C > T).$$

[3] More specific, the values are $s = 0.2$, $b = 0.5$, $m = 0$, and $\mu = 0.25$).

3.4 Predicted preferences for payment attributes

Depending on the choice of payment parameters, higher or lower responsibility can be modeled. In this section, preferences for or against these payment parameters are derived theoretically with the aid of Equation (3.4). Because payments at risk and changes in mark-ups are not of interest in the Swiss context, these attributes are neglected and physician utility reads

$$\upsilon(E[\Pi^{\text{PBR}}], \rho) = \upsilon(\beta_b b + \beta_m m + \beta_L L + \beta_N N + \beta_T T + \beta_\rho \rho), \tag{3.6}$$

with $\upsilon'(\cdot) > 0$, $\upsilon''(\cdot) < 0$. According to Gaynor et al. (2004), the number of physicians (N) in a panel working under the same target is an important decision variable for physicians to join a network. Implementing network-level incentives introduces the problem of moral hazard and the intensity of incentives might depreciate as panel size increases. Thus, one may expect preferences for medium size panels. Hence, in addition to the five attributes discussed previously, the number of physicians in the network is included in the DCE (see Section 3.5). The variables b, m, L, N, T and ρ now denote the alternative-specific attribute levels and the β's are the parameters of interest mirroring physicians' preference weights. Again, the risk premium permits to measure the price an insurer has to pay for introducing budget co-responsibility.

It is assumed that physicians are not completely certain of ending up in the state 1 or state 2, respectively, so that $0 < \tau < 1$. The first derivative of expected profit with respect to the gain-sharing bonus parameter is given by $\partial E[\Pi^{\text{PBR}}]/\partial b = \tau(T - C_1) > 0$. Thus, physicians are predicted to prefer higher bonuses so that $\beta_b > 0$ is expected.[4]

Increasing the loss-sharing malus parameter m is undesired by physicians because $\partial E[\Pi^{\text{PBR}}]/\partial m = -(1-\tau)(C_2 - T) < 0$. A higher malus parameter means that physicians have to bear a higher share of cost above target if they end up in state 2 and therefore $\beta_m < 0$ is predicted.

4 Again, we assume that $C_1 < T < C_2$ so that indifference arising from $C_1 = T = C_2$ is excluded.

The stop-loss provision limit is not modeled in Equation (3.4), but increasing L decreases τ and reduces (increases) gains (losses) in absolute terms. Therefore, physicians are predicted to dislike an increase in the stop-loss provision leading to $\beta_L < 0$. Further, the equation does not allow to derive predictions for network size N. In this case, expected preferences are discussed in the next section.

Increasing the spending target T increases expected profit because $\partial E[\Pi^{\mathrm{PBR}}]/\partial T = \tau b + (1-\tau)m > 0$ predicting that physicians like higher targets and therefore dislike a target reduction. Thus, one expects that $\beta_T > 0$ as long as at least b or m is positive.

Finally, increasing the risk payment is predicted to have a positive effect on physician utility because $v'_\rho > 0$ so that $\beta_\rho > 0$ is expected. The predicted preferences are summarized in Table 3.1.

3.5 Design of the discrete choice experiment

Physicians' preferences for budgetary co-responsibility are measured using a discrete choice experiment (DCE) with Equation (3.6) from Section 3.3 constituting the main effects specification. This section turns to the choice of attributes and attribute levels that allow measuring physicians' preferences for differently designed budgetary co-responsibility.

The gain-sharing bonus (b) representing the share of potential cost savings (target minus actual cost) and the loss-sharing malus (m) measuring the share of excess cost (actual cost minus target) to be borne by the network is modeled using the attributes BON and MAL with six levels ranging from zero to 50 percent. Higher values are expected to be very unrealistic in the Swiss context.

In practice, the stop-loss limit (L) for GPs is often approximately CHF 10,000 per patient per year (1 CHF $\approx$ 1.1 USD in 2011). For specialists, this value is very low and costs are likely to reach this limit. Therefore, the stop-loss limit (LIM) has three levels being CHF 10,000, 20,000, and 30,000 per patient per year. For an international

Attributes	**Expected sign**	**Description of attributes and their levels**
Bonus (BON)	$\beta_b > 0$	Share of cost savings paid to network of 0, 10, 20, 30, 40, or 50 percent
Malus (MAL)	$\beta_m < 0$	Share of excess cost borne by network of 0, 10, 20, 30, 40, or 50 percent
Limit (LIM)	$\beta_L < 0$	Stop-loss provision limit per patient and year of CHF 10,000, 20,000, or 30,000
Physicians (PHY)	$\beta_N \lesseqgtr 0$	Number of network members with same target of 10, 50, or 100 physicians
Target (TAR)	$\beta_T > 0$	Spending target compared to non-MC insured cost reduced by 0, 5, 10, 15, 20, or 25 percent
Payment (PAY)	$\beta_\rho > 0$	Risk payment per insured per month (IPM) of CHF 0.00, 0.50, 1.00, 1.50, 2.00, or 2.50 per IPM

Table 3.1: Summary of attributes, levels, and expected signs

comparison, the HMO analyzed by Gaynor et al. (2004) uses a stop-loss provision limited at USD 15,000 ($\approx$ CHF 13,630) for primary care physicians.

The attribute PHY representing the team size of a network (N) is important because intensity of incentives may decrease with panel size and imposing network-level incentives might introduce moral hazard. On the other hand, larger networks are better able to manage financial risks. The HMO analyzed by Gaynor et al. (2004) have physician panels ranging from three to 30. The present DCE models networks with 10, 50, and 100 physicians.

The spending target (TAR) is included in the DCE as percentage reductions of the reference budget determined upon the cost of comparable non-MC insured citizens. Reduction in spending target ranges from zero to 25 percent using intervals of 5 percent.

Finally, monetary compensation for additional risk (ρ) is included as risk payments (PAY) per insured per month (IPM). In 2010, a major Swiss health insurer paid approximately CHF 1.50 per IPM and therefore PAY is defined to range from zero to CHF 2.50 per IPM (see Table 3.1).

In each scenario respondents were asked to choose between two alternative networks (Network A or B) differing only in their payment mechanism and team size or to remain working independent (no-network option). As long as physicians are not forced to work in networks, general opposition against network participation that is regardless of network-specific characteristics is of great relevance. Including the opt-out option in the choice-based conjoint analysis allows the quantification of this resistance. Table 3.2 shows one choice scenario presented to physicians.

Attributes	**Attribute levels**	
	Network A	Network B
Share of cost savings paid to network as a bonus	50 percent	30 percent
Share of excess cost borne by network as a malus	50 percent	50 percent
Stop-loss provision limit per patient and year	CHF 10,000	CHF 20,000
Physicians in network with same target	10 phy.	50 phy.
Target reduction compared to non-MC insured	10 percent	0 percent
Risk payment per insured per month (IPM)	CHF 1.50	CHF 1.00
Choice: I prefer to join... Network A ☐, Network B ☐, or no network ☐.		

Table 3.2: Example of a three-alternative choice scenario

The total of six attributes and their levels combine to form 11,664 ($=6^4 \times 3^2$) possible combinations of alternative payment systems. Using the D-optimality criteria, 80 hypothetical alternatives were selected and grouped to 10 binary choice scenarios in 4 blocks.[5]

3.6 Utility specification and econometric model

Preferences are measured based on the stochastic utility maximization theory [Luce (1959), Manski (1977), McFadden (1981)]. The utility of alternative payment mechanisms is defined as a function of alternative-specific attribute levels. While respondent's utility from network participation is specified as linear in network attributes, the utility from independent private practice (no-network option) is given by an alternative-specific constant [compare Marshall et al. (2009)]. For later interpretation, a network

5 The experiment was designed using the JMP software.

constant (NETW) is used instead, being one for network alternatives (Network A or B) and zero otherwise.

The levels for the three attributes BON, MAL, and LIM are included as categorical characteristics, while PHY, TAR, and PAY are treated as continuous variables. In the case of remaining independent and joining no network (no-network option), PHY is defined to be one. In contrast, all network options require a value higher then one so that including PHY as a categorical variable predicts the outcome perfectly. Thus, PHY is included as a continuous variable. Testing the functional relation between TAR and utility supports a linear specification so that TAR is included as a continuous variable. The price attribute PAY is assumed continuous to facilitate the derivation of willingness-to-pay values. The same is true for the calculation of marginal rates of substitution for TAR (see Section 3.9).

Two different models are estimated. The deterministic part of the random utility for the first specification (Model A) reads

$$\begin{aligned}\beta' x \;=\; & \sum_{i=1}^{5} \beta_b^i \cdot \mathrm{BON}_{i0} + \sum_{i=1}^{5} \beta_m^i \cdot \mathrm{MAL}_{i0} + \sum_{i=2}^{3} \beta_L^{i-1} \cdot \mathrm{LIM}_{i0} \\ & + \beta_N^1 \cdot \mathrm{PHY} + \beta_N^2 \cdot \mathrm{PHY}^2 + \beta_T \cdot \mathrm{TAR} + \beta_\rho \cdot \mathrm{PAY} + \beta_c \cdot \mathrm{NETW}.\end{aligned} \tag{3.7}$$

The second specification (Model B) includes additional interaction terms between the network constant and demographic variables. The first three interactions are between NETW and physician's specialization. General practitioners (GPs) constitute the reference category and are compared to specialists without ($\mathrm{SP}_{w/o}$) and with ($\mathrm{SP}_{w/}$) surgical activities, and psychiatrists (PSY). The interaction with physician's age (AGE) and gender (MALE) enables to investigate if network participation differs between generations and between male and female physicians, respectively. Finally, network participation is interacted with a dummy TAU being one if physicians think their probability of producing cost below comparable practices is above 50 percent [$\tau > 0.5$ in Equation (3.2)] and zero otherwise.

Taste parameters are simulated by maximum likelihood using random-coefficient logit models. This has three important advantages compared to the conventional standard logit model. First, it allows for preference heterogeneity among physicians. Second, it permits unrestricted substitution patterns in the present three-alternative case. And third, it allows for correlation of unobserved factors over choice scenarios. Choice probabilities are given by

$$P_{ni} = \int \prod_{t=1}^{T} \frac{exp(\beta' x_{nit})}{\sum_{j=1}^{J} exp(\beta' x_{njt})} f(\beta|\mu, \sigma) d\beta, \tag{3.8}$$

where $f(\beta|\mu, \sigma)$ is called mixing (or population) distribution for coefficient β with mean parameter μ and standard deviation σ [see Train (2003), Chapter 6]. The index n indicates the physician and subscript i the alternative available in the choice set of choice scenario $t = 1, ..., 10$.

All mixing distributions for the random coefficients are assumed to be normal even if this contradicts microeconomic theory for some respondents, e.g. PAY is expected to be liked by all respondents. Non-negative or non-positive preferences are commonly modeled using the log-normal distribution. However, the log-normal distribution has many disadvantages in practice, e.g. convergence problems and implausible values due to its long fat tails. Treating the coefficients for PAY and TAR fixed facilitates the derivation of willingness-to-pay (WTA) values or marginal rates of substitution, respectively. To ease the estimation of Model B due to the high number of parameters to estimate, coefficients pertaining to the interaction terms are assumed fixed.[6]

The mixing distribution $f(\beta|\mu, \sigma)$ can be used to derive physician-level parameters by combining population information with observed respondent's choices [see Train (2003), Chapter 11 for more details]. The conditioned physician-level distribution is proportional to the product of the unconditioned population distribution and the probability that a respondent's choice sequence would be observed if his or her coefficient were β. If a respondent's choices are observed, all quantities are known to derive in-

[6] The estimation of a model with random coefficients for all interaction terms did not converge.

dividual preference weights (see Section 3.8.1). These coefficients can then be used to calculate physician-specific WTA values (see Section 3.8.2).

3.7 Data

The discrete choice experiment (DCE) was included in an online-survey addressed to approximately 11,000 Swiss physicians working in ambulatory care. A pretest was conducted in July 2011 to check the choice of attributes, their levels, and the understanding of the questionnaire. Comments indicated that only minor changes were required and the main survey was finally fielded in August 2011. The rate of return was about 14 percent resulting in 13,073 observed choices by 1,521 physicians. Table 3.3 summarizes respondent demographics for the sampled physicians. First evidence that many physicians oppose network participation is given by the fact that about one fifth of all respondents (22 percent) always chose to continue to work in independent private practices (no-network option) instead of choosing one of the presented network alternatives. Less than one percent always chose the network options.

			Percentiles		
Variable	MN	SD	5^{th}	MD	95^{th}
Age of physicians (in years)	53.54	8.37	40.00	54.00	66.00
Years of experience	25.88	10.01	11.00	26.00	39.00
Share of males	0.80	0.40	0.00	1.00	1.00
Married	0.79	0.40	0.00	1.00	1.00
Number of children under 18	1.67	1.70	0.00	2.00	4.00
Urban practice	0.52	0.50	0.00	1.00	1.00
Suburban practice	0.23	0.42	0.00	0.00	1.00
Rural practice	0.25	0.43	0.00	0.00	1.00
General practitioners	0.45	0.50	0.00	0.00	1.00
Specialists without surgery	0.12	0.32	0.00	0.00	1.00
Specialists with surgery	0.13	0.33	0.00	0.00	1.00
Psychiatrists	0.17	0.37	0.00	0.00	1.00

Note: General practitioners include gynecologists and pediatricians

Table 3.3: Respondent demographics (Swiss ambulatory care physicians, 2011)

Average age of sampled physicians is 54 years and equals average age reporter by the Swiss Medical Association for all members working in practices in 2010 [Kraft (2010)]. Respondents have 26 years of job experience on average. Males are slightly oversampled with a share of 80 percent compared to 68 percent from the source cited above. The majority (79 percent) is married, while 8 percent are divorced, 6 percent live in concubinage, and 6 percent are single. The median respondent has two children below 18 years. Respondents are located in urban (52 percent), suburban (23 percent), and rural (25 percent) areas. General practitioners (including gynecologists and pediatricians) account for 45 percent of respondents, specialists without surgical activities for 12 percent, specialists with surgical activities for 13 percent, and 17 percent are psychiatrists. The remainder (18 percent) did not declare themselves to belong to one of these categories. The majority of physicians work in independent single practice (52 percent). Kraft (2010) reports a share of 63 percent working in single practice indicating an undersampling of single practice physicians. About a third works in shared practice on their own account (30 percent), while only 5 percent work in shared practice on common account. Network participation in Switzerland is low and predominately characterized by networks where physicians continue to work on their own account (12 percent). Common-account networks are the exception (1 percent). Average team size in shared practice is 2.75 physicians.

Physicians were asked about their experience with different payment mechanisms. Only 6 percent of sampled physicians have experience with capitation. The share of private-practice physicians stating that they have never been paid through a fixed salary is lower with 4 percent. Regarding a gain-sharing bonus or loss-sharing malus, 6 percent have experience with a bonus and 4 percent with a malus. These low shares show that most Swiss physicians have no experience with alternative payment mechanisms. Information campaigns addressed to physicians could lower expected resistance against cost sharing.

Parameter τ in Equation (3.2) denotes the probability of producing annual cost below the spending target. In the survey, respondents were asked to assess their own probability of producing total cost (including pharmaceuticals and referrals to specialists and hospitals) lower than comparable practices. Response options ranged from zero to 100 percent in steps of 10 percent. On average, physicians stated their probabilities to be at 52 percent (median category is 50 percent). Of these surveyed, 11 percent state that they are certain to be over the target, while 8 percent are sure to be below. These probabilities are used to investigate if physicians who assess their probabilities to be above 50 percent ($\tau > 0.5$) have a lower resistance against budgetary co-responsibility.

In addition, physicians were asked if they believe that decreasing health care expenditure is only possible with decreasing treatment quality. Of this query, 79 percent think that decreasing expenditure is impossible without degradation in treatment quality, whereas only 10 percent think that reducing cost is possible without affecting quality. Physicians see the highest potential for reducing health care expenditure via the prescription of generic drugs which contradicts the strong resistance against generic drug lists (see Section 3.8). The majority of 76 percent stated that they consider cost when choosing treatments for their patients while 11 percent do not consider cost when deciding about medical services provided. Approximately 60 percent perceive cost discussions in Switzerland to endanger health care quality, while 23 percent think that quality is unaffected. The remainder is indifferent.

3.8 Results

Table 3.4 shows population parameters (μ and σ) for both random-coefficient logit specifications (Model A and B) discussed in Section 3.6. The left panel pertains to Model A, while Model B (with interactions) is shown in the right panel. The discussion below concentrates on the values and standard errors (S.E.) of Model B.

3.8.1 Preferences for payment attributes

As predicted in Section 3.4, the preference weights for a gain-sharing bonus are positive. They are increasing with attribute levels with one exception: a bonus of 40 percent is valued less than a bonus of 30, which contradicts rational behavior. In general, a quadratic relationship between network utility and bonus levels is found. Increasing the bonus has a stronger impact on utility in the lower domain. The mean parameters for the malus levels are negative and monotonically decreasing in attribute levels as predicted. The effect of a malus on physician's utility is found to be linear. A higher stop-loss limit increases physician's expected total costs. As predicted, estimated mean parameters reveal a decrease in respondent's utility if LIM rises. The positive estimates for PHY and PHY^2 show that increasing team size is preferred by physicians because risk can be better diversified in larger networks. The coefficient pertaining to TAR measures preferences for an increase in the spending target. However, insurers are interested in decreasing TAR to achieve cost savings. A reduction is undesired from the physician perspective because it reduces expected profit. The risk payment increases utility as expected. The strongest impact on utility is found for the network constant (NETW) with its strongly negative mean parameter. This reveals a strong opposition against network participation of Swiss physicians.

The interactions between NETW and job categories reveal that GPs have the lowest resistance against network participation, followed by specialists without surgical activities, and psychiatrists. The strongest opposition is found for specialists with surgical activities. No significant preference heterogeneity for network participation is found due to respondent's age and gender. In contrast, physicians who believe that their probability of meeting the spending target is higher than 50 percent, have a lower resistance against network participation. This is intuitive because they are likely to profit from a gain-sharing bonus. However, the magnitude of the coefficient is not high enough to compensate general resistance against network participation.

All estimated mean parameters other than β_{age} and β_{male} are significant with a p-value below 0.01.

				Model A				**Model B**			
				Mean (μ)		Std.Dev. (σ)		Mean (μ)		Std.Dev. (σ)	
Attribute	Level	Abbrev.	Coeff.	Value	S.E.	Value	S.E.	Value	S.E.	Value	S.E
Gain-sharing bonus of	10 percent	BON_{10}	β_b^1	0.82	(0.14)	0.16	(0.40)	0.83	(0.15)	0.46	(0.27)
	20 percent	BON_{20}	β_b^2	1.09	(0.12)	0.30	(0.23)	1.10	(0.13)	0.40	(0.23)
	30 percent	BON_{30}	β_b^3	1.30	(0.12)	0.14	(0.24)	1.36	(0.12)	0.15	(0.19)
	40 percent	BON_{40}	β_b^4	1.07	(0.14)	0.45	(0.22)	1.06	(0.16)	0.61	(0.36)
	50 percent	BON_{50}	β_b^5	1.38	(0.13)	0.34	(0.14)	1.42	(0.12)	0.07	(0.21)
Loss-sharing malus of	10 percent	MAL_{10}	β_m^1	-0.77	(0.11)	0.17	(0.15)	-0.79	(0.11)	0.13	(0.15)
	20 percent	MAL_{20}	β_m^2	-0.88	(0.11)	0.17	(0.11)	-0.87	(0.11)	0.08	(0.16)
	30 percent	MAL_{30}	β_m^3	-1.31	(0.12)	0.25	(0.14)	-1.30	(0.13)	0.47	(0.20)
	40 percent	MAL_{40}	β_m^4	-1.66	(0.14)	0.07	(0.15)	-1.67	(0.14)	0.24	(0.16)
	50 percent	MAL_{50}	β_m^5	-2.02	(0.12)	0.27	(0.12)	-2.03	(0.12)	0.02	(0.14)
Stop-loss provision limit of	CHF 20,000	LIM_{20}	β_L^1	-0.26	(0.08)	0.08	(0.09)	-0.24	(0.08)	0.08	(0.10)
	CHF 30,000	LIM_{30}	β_L^2	-0.31	(0.09)	0.06	(0.09)	-0.30	(0.09)	0.20	(0.12)
Number of physicians		PHY	β_N^1	0.03	(0.00)	0.00	(0.00)	0.03	(0.00)	0.01	(0.00)
Physicians^2		PHY^2	β_N^2	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Spending target $^{a)}$		TAR	β_T	0.04	(0.00)	–	–	0.04	(0.00)	–	–
Risk payment $^{b)}$		PAY	β_ρ	0.42	(0.04)	–	–	0.44	(0.04)	–	–
Network participation		NETW	β_c	-5.73	(0.25)	4.35	(0.20)	-5.14	(0.95)	4.20	(0.20)
× specialist w/o surgery		$SP_{w/o}$	$\beta_{sp}^{w/o}$	–	–	–	–	-1.30	(0.41)	–	–
× specialist w/ surgery		SP_w	$\beta_{sp}^{w/}$	–	–	–	–	-3.33	(0.39)	–	–
× psychiatrist		PSY	β_{psy}	–	–	–	–	-2.09	(0.50)	–	–
× physician age		AGE	β_{age}	–	–	–	–	-0.00	(0.02)	–	–
× male physician		MALE	β_{male}	–	–	–	–	0.10	(0.36)	–	–
× physician w/ $\tau > 0.5$		TAU	β_τ	–	–	–	–	0.98	(0.26)	–	–

Note: $^{a)}$ in %-points; $^{b)}$ in CHF per MC-insured per month.

Table 3.4: Preferences for payment attributes – regression results

3.8.2 Willingness to accept budgetary co-responsibility

The estimated parameters discussed above can be used to predict how much it costs an insurer or network to attract physicians to work in a network with budgetary co-responsibility. Different methods can be applied to derive willingness-to-accept (WTA) values from random-coefficient models. Taking the ratio of population mean parameters (μ) from Table 3.4 is the simplest way as long as the price attribute has a fixed coefficient and the coefficient pertaining to the attribute of interest is normally distributed. However, Sillano and Ortuzar (2005) recommend to determine WTA point estimates using individual-level taste parameters [see Train (2003), Chapter 11 for more details]. Table 3.5 describes physician-specific WTA values derived from Model A and B, respectively. The mean (MN) and median (MD) values do not significantly differ from each other supporting the assumption of a symmetric mixing distribution.

On average, introducing a gain-sharing bonus of 10 percent lowers the required compensation by 1.89 CHF/IPM (1 CHF $\approx$ 1.1 USD in 2011). Compensation reduces by 2.51 CHF/IPM for BON_{20}, by 3.11 for BON_{30}, and by 2.41 CHF/IPM for BON_{40}. Granting the highest bonus level of 50 percent reduces the payment by 3.25 CHF/IPM. Again, the value for BON_{40} is not in line with an expected monotonic decrease in required compensations.

A loss-sharing malus of 10 percent has to be compensated on average with 1.80 CHF/IPM. This compensation increases to 1.99 CHF/IPM for MAL_{20}, 2.98 CHF/IPM for MAL_{30}, and 3.82 CHF/IPM for MAL_{40}. A malus of 50 percent requires an average compensation to the tune of 4.62 CHF/IPM. Comparing the values between BON and MAL shows that physicians are surprisingly accepting a symmetric bonus/malus of 30 percent without being compensated for. A bonus and malus of 50 percent, where insurers and networks share cost savings or exceeding costs in equal measure, is estimated to have an average WTA to the tune of 1.37 CHF/IPM.

Accepting a stop-loss provision limit of CHF 20,000 instead of CHF 10,000 requires an average payment of 0.55 CHF/IPM while a limit of CHF 30,000 requires 0.70 CHF/IPM. Physicians prefer to work in larger networks because risk diversification

	Model A				Model B			
			Percentiles				Percentiles	
Attribute	MN	MD	5^{th}	95^{th}	MN	MD	5^{th}	95^{th}
Gain-sharing bonus of								
10 percent	-1.94	-1.93	-2.01	-1.87	-1.89	-1.88	-2.17	-1.67
20 percent	-2.56	-2.56	-2.77	-2.39	-2.51	-2.50	-2.81	-2.28
30 percent	-3.07	-3.07	-3.16	-3.00	-3.11	-3.11	-3.19	-3.04
40 percent	-2.52	-2.52	-2.86	-2.12	-2.41	-2.41	-2.91	-1.91
50 percent	-3.25	-3.24	-3.72	-2.90	-3.25	-3.25	-3.32	-3.18
Loss-sharing malus of								
10 percent	1.81	1.81	1.65	1.99	1.80	1.80	1.66	1.91
20 percent	2.07	2.07	1.85	2.29	1.99	2.00	1.90	2.08
30 percent	3.09	3.09	2.76	3.45	2.98	2.97	2.44	3.57
40 percent	3.92	3.92	3.82	4.03	3.82	3.82	3.49	4.15
50 percent	4.75	4.75	4.37	5.18	4.62	4.62	4.59	4.66
Stop-loss provision limit of								
CHF 20,000	0.62	0.62	0.49	0.75	0.55	0.55	0.44	0.67
CHF 30,000	0.72	0.73	0.61	0.83	0.70	0.69	0.38	1.03
Number of physicians $^{a)}$	-0.72	-0.71	-0.78	-0.66	-0.66	-0.66	-0.77	-0.57
Physicians^2	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.01
Spending target $^{b)}$	-0.10	–	–	–	-0.10	–	–	–
Network participation	13.90	18.67	-1.24	20.21	12.08	15.15	-2.57	19.13
× specialist w/o surgery	–	–	–	–	2.96	–	–	–
× specialist w/ surgery	–	–	–	–	7.59	–	–	–
× psychiatrist	–	–	–	–	4.78	–	–	–
× physician age $^{c)}$	–	–	–	–	0.00	–	–	–
× male physician	–	–	–	–	-0.23	–	–	–
× physician w/ $\tau > 0.5$	–	–	–	–	-2.24	–	–	–

Note: WTA values are shown in CHF per insured per month (IPM). 1 CHF ≈ 1.1 USD at 2011 exchange rates. Units: $^{a)}$ per 10 physicians, $^{b)}$ in %-points, $^{c)}$ in years.

Table 3.5: Individual-level WTA values of Swiss ambulatory care physicians

regarding patients with unexpected high costs is more easily manageable. For an increase of network size by ten physicians, respondents are willing to reduce compensation by 0.66 CHF/IPM.[7]

The reason why insurers are interested in introducing budgetary co-responsibility is to contain medical expenditure. Therefore, they have an interest in imposing a spending

[7] The effect of the quadratic term is negligible.

target below cost of comparable non-MC insured individuals. Conversely, reducing the target shrinks expected profits for networks and requires a compensation payment for additional risk. For each percentage point reduction in TAR, physicians ask for an average compensation of 0.10 CHF/IPM. One should keep in mind that a reduction in TAR has only an effect for insurers and physicians if a bonus/malus is introduced [see Equation (3.1) in Section 3.3].

The largest WTA values are found for joining a network regardless of network-specific payment mechanisms. On average, GPs can be attracted to participate in networks if they receive 12.08 CHF/IPM, which exceeds by far current compensation payments of 1.50 CHF/IPM. Specialists without surgical activities ask for a payment of 2.96 CHF/IPM in excess of what GPs demand, while psychiatrists ask for additional 4.78 CHF/IPM. Physicians with surgical activities have to be compensated by approximately 1.6 times the amount for GPs. Willingness to accept does not significantly change with respondent's age and gender. Physician's expectation of having costs below comparable practices reduces the required payment by 2.24 CHF/IPM.

3.9 Discussion and conclusions

In Switzerland, increasing health care expenditure fuel political debates of possible regulatory changes to promote Managed Care (MC). While MC constitutes the dominant form of health insurance in the United States, only 12.5 percent of Swiss citizens are MC insured. Two major changes in regulation are considered. First, the government should be allowed to force health insurers to write MC contracts. Secondly, the introduction of budgetary co-responsibility for physicians working in ambulatory care to encourage physicians to control costs is intended. However, introducing incentives through budgetary co-responsibility is only realistic on network level and not on individual basis. Global budgets for panels of physicians permit risk diversification. Therefore, introducing budgetary co-responsibility for all physicians equals an enforcement of network participation. On the other hand, if budgetary co-responsibility is only implemented for

MC organizations, physicians' voluntary network participation and risk bearing has to be compensated. Because insurers are not allowed to establish their own MC organizations providing care, they have to rely on contracting with independent organizations. Increasing the share of MC-insured citizens requires the recruitment of additional physicians to work in networks or Maintenance Organizations (HMOs), which is derailed by imposing budgetary co-responsibility. Physicians have to be compensated for giving up fee-for-service and to accept budgetary co-responsibility. Therefore, it is crucial to assess if enough physicians can be won over to join networks and how much an insurer would have to pay for attracting physicians to join networks.

The WTA values for the payment attributes presented in this study can be used to predict required compensations asked to accept payment systems with different incentive intensities. Let us consider a soft version of budgetary co-responsibility, e.g. one with a symmetric bonus/malus of 10 percent, a stop-loss provision of CHF 10,000, a network size of 50 physicians, and a spending target which is 10 percent below the cost of a comparable non-MC insured collective. In this case, total compensation to attract a general practitioner is 9.69 CHF per MC-insured per month.[8] If we further assume that a physician has 600 patients enrolled, an average payment of CHF 5,814 per month is required. Average income for a Swiss general practitioner is CHF 16,118 [see Reichert (2010)]. In this case, GP income has to rise by 36 percent to attract them to accept this form of budgetary co-responsibility. These results show that implementing a low budgetary co-responsibility requires already a high compensation. It is unlikely that cost reductions for health insurers are high enough to allow them to pay such a high price for introducing incentives through budgetary co-responsibility. The literature review by Berchtold and Hess (2006) assesses potential cost containments through MC to be between 20 and 30 percent, mainly due to gatekeeping and capitation. Schwenkglenks et al. (2006) show that replacing fee-for-service based health

8 Total compensation asked is given by $\text{BON}_{10}^{\text{WTA}} + \text{MAL}_{10}^{\text{WTA}} + 5 \times \text{PHY}^{\text{WTA}} + 10 \times \text{TAR}_{10}^{\text{WTA}} + \text{NETW}^{\text{WTA}}$ and equals $-1.89 + 1.80 - 5 \times 0.66 + 10 \times 0.10 + 12.08$. Note that PHY^{WTA} is measured for an increase of ten physicians and therefore multiplied with five instead of fifty (compare Table 3.5).

insurance with gatekeeping amounts to cost savings between 15 and 19 percent not attributable to risk selection.

Instead of compensating physicians with additional income, an insurer could also try to design a payment mechanism, which is accepted without monetary compensation. Then, the question is for example which spending target physicians accept if a bonus/malus system is introduced. The marginal rates of substitution between the spending target and the attribute levels of bonus and malus can be used to estimate accepted spending targets. Introducing a symmetric bonus/malus of 10 or 30 percent is accepted if the spending target is one percentage point below the cost of comparable non-MC insured individuals (see Table 3.6 in the Appendix). The highest target reduction can be achieved for a bonus/malus of 20 percent (minus 5 percentage points). In contrast, the introduction of higher levels is only accepted if the spending target is set 14 percentage points above cost of comparable non-MC insured individuals.

Therefore, the discussed health care reform which intends to force insurers to write MC contracts to increase the market share of MC is unlikely to meet its objectives if budgetary co-responsibility is introduced at the same time.

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Appendix

		Model B			
				Percentiles	
Attribute	Level	MN	MD	5^{th}	95^{th}
Gain-sharing bonus of	10 percent	-18.79	-18.68	-21.61	-16.57
	20 percent	-24.92	-24.81	-27.93	-22.69
	30 percent	-30.95	-30.92	-31.73	-30.24
	40 percent	-23.92	-23.96	-28.93	-19.01
	50 percent	-32.29	-32.30	-32.97	-31.59
Loss-sharing malus of	10 percent	17.86	17.85	16.50	19.01
	20 percent	19.83	19.84	18.90	20.72
	30 percent	29.63	29.53	24.27	35.50
	40 percent	37.94	37.96	34.68	41.27
	50 percent	45.97	45.97	45.65	46.30
Stop-loss provision limit of	CHF 20,000	5.50	5.51	4.35	6.70
	CHF 30,000	6.92	6.86	3.78	10.27

Note: Marginal rates of substitution with respect to TAR (in %-point).

Table 3.6: Accepted spending targets (marginal rates of substitution)

PREFERENCES FOR HEALTH INSURANCE IN GERMANY AND THE NETHERLANDS – A TALE OF TWO COUNTRIES

BY

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SUMMARY

Using two Discrete Choice Experiments, this contribution measures willingness to pay (WTP) for health insurance attributes in Germany and the Netherlands. Two research questions naturally arise. First, what are the preferences with regard to contract attributes in the two countries? Second, how do the preferences differ between the two countries? Based on hierarchical Bayes mixed logit estimates, the distributions of individual-specific WTP values are derived and compared. While the two populations agree in their resistance against Managed Care-type attributes, German respondents would have to be compensated much more for giving up free physician choice and accepting a physician list. In addition, they reveal a stronger preference for their current status quo contract than the Dutch, who had to specifically choose a policy as part of the 2006 reform.

Chapter 4

Preferences for Health Insurance in Germany and the Netherlands – A Tale of Two Countries

4.1 Introduction and motivation

Governments in industrial countries have been trying to respond to the rising cost of health care by modifying health insurance (copayments, deductibles, bonus options for no claims) or changing the provision of health care (Managed Care). However, it is far from clear whether citizens are ready to accept these changes. If they conceive e.g. Managed Care as constraining their choice of physician, compensation must be offered to gain their acceptance. In insurance-based systems, observed past choices provide little guidance because they are distorted by regulated contributions to health insurance, while in National Health Service-type systems, medical care has a tax price that is the same at a given income level.

In this situation, experimental evidence concerning citizens' preferences may be of value to avoid costly mistakes by health insurers and policy makers. The present contribution purports to report on so-called market experiments of the Discrete Choice (DCE) type in two insurance-based countries, Germany and the Netherlands. It should be of interest for at least three reasons. First, international comparisons of preferences for health insurance are rare. Second, German health policy has been characterized by new laws and regulations that have increased uncertainty on the part of patients (see Boecken et al. (2005)). By way of contrast, in the Netherlands a major pro-competitive reform was enacted in 2006, accompanied by a major information campaign designed to help citizens choose a health insurance contract. This raises the question of whether this provision of information makes a difference in the way choices are made. Third, the two experiments deal with potential crossovers between the two countries. The status quo in the Netherlands is gatekeeping by physicians (a variant of Managed Care), whereas consumers possibly prefer free choice of physician, which constitutes the status quo in Germany (where policy makers consider introducing Managed Care). Also, the Dutch population is familiar with a bonus for no claims reminiscent of auto liability insurance but might want to return to conventional health insurance with almost no copayment (see VWS (2005)), whereas such bonus options have been discussed in Germany as a reform option.

Against this backdrop, this paper seeks to answer two questions: What are the preferences of German and Dutch consumers with regard to attributes of health insurance? Are they similar or dissimilar? In the context of this second question, it is hoped to find evidence on whether the information campaign launched by the Dutch government in the context of the 2006 reform had an effect.

This paper is organized as follows. Section 4.2 shortly discusses the health insurance systems in the two countries. Section 4.3 is devoted to the hierarchical Bayes mixed logit model used to estimate preferences for insurance options and Section 4.4 compares the two data sets. Sections 4.5 and 4.6 are devoted to the country-specific DCEs while Section 4.7 compares the results for the two countries before concluding remarks are made in Section 4.8.

4.2 Health insurance in Germany and the Netherlands

This section provides some institutional background in the aim of motivating the choice of insurance attributes and attribute levels in the respective DCEs.

In Germany, individuals with a gross monthly income exceeding 3,862 Euros (as of 2004) can opt out of statutory health insurance (SHI) scheme in favor of private health insurance. Individuals with an income below this threshold (about 88 percent of German citizens) are obliged to join one of the 300 statutory sick funds, while approximately 6 percent are fully covered by private insurance. The remaining 6 percent are civil servants and pensioners who are insured by governmental schemes (see Schreyoegg and Grabka (2010), Tamm et al. (2007)). This study is limited to SHI members only. At the time of the survey (2005), members of a SHI were obliged to sign the status quo contract described in Table 4.3 of Section 4.5.1, with little variation. German SHI is financed through income-related premiums that are equally paid by employers and insured individuals (see Grabka (2004)). The last major reform occurred in the year 2000. It introduced choice of sickness fund for SHI members. A minor change followed in 2004 in the guise of a copayment of 10 Euros per quarter and initial physician visit. Referrals to a specialist by general practitioners are exempted. Otherwise, there continues to be free physician choice (see Table 4.3).

The Dutch health insurance system underwent a major reform in 2006, with two main features. First, all health insurers were obliged to offer a uniform basic health insurance plan. Second, every citizen had to explicitly choose a health insurance policy covering at least the basic package with the option to purchase additional coverage voluntarily. In the Netherlands, health care is financed through two sources: income-related payments to the risk-adjustment scheme, and direct premium payments to an insurer of one's choice which sets its own community-rated premiums (see Becker-Leukert et al. (2007)).

4.3 Econometric model

In this study, preferences for health insurance options are estimated using a hierarchical Bayes mixed logit model for binary choices. The dependent variable (y) is one if the respondent opts for the hypothetical alternative rather than the current (status quo) contract and zero otherwise. Due to increased computation power and developed simulation methods, the mixed (or random-coefficient) logit model plays an increasing role in applied econometrics. It contains the standard and random-effects logit models as special cases but allows for random taste variation, unrestricted substitution patterns, and correlation of unobserved factors over time (see Train (2003), Chapter 6). It implements the random utility model, which for individual n and alternative i at time t is given by

$$U_{nit} = \beta_n' x_{nit} + \varepsilon_{nit}, \text{ with } \varepsilon_{nit} \overset{iid}{\sim} EV, \tag{4.1}$$

where alternative i is chosen if (and only if) $U_{nit} > U_{njt}\ \forall j \neq i$ (EV = extreme value). The mixed logit choice probability is given by

$$P_n(y_n|b, W) = \int \prod_t \frac{e^{\beta_n' x_{ny_{nt}t}}}{\sum_j e^{\beta_n' x_{njt}}}\ k(\beta_n|b, W)\ d\beta_n, \tag{4.2}$$

where the vector $x_{ny_{nt}t}$ contains the attribute levels of the chosen insurance contract of individual n at time t and $k(\beta_n|b, W)$ is the prior distribution of β_n with parameters b and W.[1] Therefore, the mixed logit model requires the specification of adequate prior distributions representing the researcher's expectations about the distribution of preferences among respondents. Most DCE studies assume normally distributed (N) coefficients, thus allowing negative and positive preferences. In some cases, microeconomic theory imposes sign restrictions on coefficients such as a negative marginal utility of the price attribute for all respondents. In such cases, the coefficients are commonly assumed to be log-normally distributed. But the log-normal distribution can cause problems because it allows unbounded coefficients with thick tails and often fails to converge with simulated maximum likelihood.

[1] In the frequentist literature, $k(\beta_n)$ is called mixture distribution giving the mixed logit its name.

This has given rise to concern about the effect of distributional assumptions on estimated preferences and willingness-to-pay values. The objective is to find distributions that are as easy to estimate as the normal and log-normal but more flexible. For example, Train and Sonnier (2005) prefer Johnson's S_B distribution to the log-normal for the cost attribute because the S_B distribution can be shaped like a log-normal but with an upper bound and thinner tails, or inverted u-shaped between a lower and an upper bound, or it can even be bimodal. Hess et al. (2005) compare different distributions for characterizing consumers' tastes with respect to changes in travel time and travel cost. Their results suggest the use of bounded distributions like the S_B distribution rather than the log-normal.

In this study, two attributes are expected to have negative coefficients only, a deductible and the premium. For them, S_B priors are estimated and tested against the log-normal alternative. A random variable $R = ln[r/(u-r)]$ is S_B distributed if $r \sim N$, where u denotes an upper bound.[2] In addition, some attributes are expected to be irrelevant to a considerable share of respondents, e.g. the availability of a counselor on the telephone (PHONE, see Tables 4.2 and 4.6, respectively). Following Train and Sonnier (2005), normal priors truncated at zero from below are assumed in these cases. The random variable R is truncated normal distributed if $R = max(0, r)$ and $r \sim N$. More detail about the choice of prior distributions is given in Sections 4.5.1 and 4.6.1 describing the design of the two DCEs.

The joint posterior density function is computed using Bayes theorem, which allows to combine the observed data with the researcher's expectations about the parameters of interest. The joint posterior used for statistical inference is given by

$$K(\beta_n|Y_n) = \frac{L(Y_n|\beta_n) \cdot k(\beta_n)}{L(Y_n)} \propto L(Y_n|\beta_n) \cdot k(\beta_n), \tag{4.3}$$

where $L(Y_n|\beta_n)$ is the likelihood of observing Y_n given β_n, $k(\beta_n)$ is the prior about β_n, and $L(Y_n)$ is the normalizing constant which is independent of β_n. It can be dropped because it does not affect the posterior's shape. Inference is performed by taking

2 Here, the lower bound is set to zero throughout.

draws from this posterior distribution and calculating its moments. The individual-level parameters are modeled using a hierarchical structure where the mean (b) and the covariance-variance matrix (W) of $k(\beta_n|b, W)$ have their own distributions $k(b)$ and $k(W)$, respectively. If independent priors are assumed, the joint prior amounts to their product so that Equation (4.3) can be rewritten as

$$K(\beta_n\ \forall n, b, W|Y) \propto \prod_n L(y_n|\beta_n) \cdot k(\beta_n|b, W) \cdot k(b) \cdot k(W). \tag{4.4}$$

Unfortunately, distribution $K(\cdot)$ does not have a standard form, which would be convenient for analyzing its properties. Still, conditional posteriors for $\beta_n\ \forall n$, b, and W can be derived (see Train (2003), Chapter 12). Given the assumption that $k(b)$ is multivariate normal and $k(W)$ is inverted Wishart distributed,[3] the conditional posterior for $b|\beta_n\ \forall n$ is multivariate normal and $W|\beta_n\ \forall n, b$ is inverted Wishart distributed. Both conditional posteriors are of standard form and easy to take draws from. In contrast, the conditional posterior for $\beta_n\ \forall n|b, W$ has no such form and would have to be directly simulated using the time-consuming Metropolis-Hastings algorithm (see Gelman et al. (2004), Chapter 11). As an alternative, Gibbs sampling from these three conditional posteriors simulates draws from the joint posterior and is much faster than simulating directly from the joint posterior. The Gibbs algorithm calls for starting values $W^{(0)}$ and $\beta_n^{(0)}\ \forall n$ and taking a draw $b^{(1)}$ from the first layer $K(b|W^{(0)}, \beta_n^{(0)}\ \forall n)$. Next, $b^{(1)}$ is used together with $\beta_n^{(0)}$ to take a draw $W^{(1)}$ from $K(W|b, \beta_n\ \forall n)$. Finally, one vector β_n per individual is simulated from $K(\beta_n|b, W, y_n)$. This procedure is repeated many times. In this study, we used 10^5 draws for burn-in and retained every 100^{th} draw from the following 10^6, resulting in 10^4 draws available for inference.

Convergence of the algorithm, indicating that the retained sample consists of draws from the correct target distribution, was checked by monitoring trace plots (see Lancaster (2004), Chapter 4) and the evolution of the ergodic mean over iterations. The ergodic mean is calculated over all previous draws up to the current iteration (see Nz-

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3 The inverted Wishart distribution is the conjugate prior of the multivariate normal distribution.

toufras (2009), Chapter 2). If it does not change after the burn-in phase, the algorithm has converged.

4.4 Data

In this section, we shortly present some socio-economic characteristics of the respondents in Germany and the Netherlands. Since the two experiments will be compared without conditioning on covariates that are likely to influence willingness-to-pay (WTP) values, the two populations should not differ too much. Respondents in Germany are on average 55 years old, those in the Netherlands, 49 years. In Germany, only respondents older than 25 years were interviewed while in the Netherlands individuals older than 18 years took part in the experiment. Both samples contain about 45 percent males, and the share of married respondents is 62 and 70 percent, respectively. The median size of the household is two persons in both samples, and stated household income is about the same. These similarities suggest that the two samples are not very different and that the comparison between them (see Section 4.7) should not be mainly driven by differences in socio-economic characteristics.

	Germany			**Netherlands**		
Characteristics	MN	MD	SD	MN	MD	SD
Age of respondent (in years)	55	56	13	49	48	15
Share of males	0.44	0.00	0.50	0.46	0.00	0.50
Share of married respondents	0.62	1.00	0.48	0.70	1.00	0.46
Number of household members	2.66	2.00	1.35	2.86	2.00	1.31
Stated household income (in Euros)[a]	2,114	2,250	983	2,431	2,250	1,027

Statistics are: means (MN), medians (MD), and standard deviations (SD)

[a] Approximation because only income brackets were indicated.

Table 4.1: Descriptive statistics of some characteristics

4.5 The choice experiment for Germany

4.5.1 Study design for Germany

The choice of attributes describing a health insurance contract is crucial for ensuring realistic scenario for the DCE. The attributes included in the experiment reflect the political debate in Germany at the time (2005) and were subjected to a pretest involving in-depth interviews with 20 persons. They all turned out to be important in a qualitative pretest. In the following, we discuss the DCE design with its attributes and attribute levels.

Attributes	**Attribute levels**
Physician choice	Free physician choice versus physician list (LIST, ±), gatekeeping (GATE, ±), and network (NETW, ±)
Second opinion	10 Euros per quarter for additional opinion versus one free second opinion per quarter (SECOP, 0^+)
Additional services	No particular services or information provided versus counselor available on the telephone (PHONE, 0^+)
Incentives	No incentives (NOINCT) versus bonus of 500 Euros for no claims (BONUS, 0^+), deductible of 500 Euros per year (DEDUC, −), bonus for preventive behavior (PREV, 0^+)
Contribution	Respondent's current annual premium (in Euros) versus changes of ±200, ±300, ±400, and ±500 Euros (PREM, −)

Note: The signs after the abbreviations in parentheses indicate our expectations about respondents' preferences: (±) positive or negative preferences possible, (+) all respondents like attribute, (−) all dislike attribute, (0^+) are indifferent or like attribute.

Table 4.2: Attributes and attribute levels (Germany)

The first attribute concerns the amount of physician choice. The status quo is free physician choice. One alternative is a physician list established by the health insurer, based on cost and quality criteria (LIST). A second alternative is gatekeeping (GATE), meaning that a primary care physician must be contacted first in the event of illness. It is only then that the patient can choose a specialist. The third, most restrictive alternative is gatekeeping combined with a list of specialists participating in a network (NETW). Again, the gatekeeping physician must be contacted first; in addition however, referrals can only be made to other network physicians (who must take part in quality assurance meetings and continued education). In total, this attribute thus has four levels.

The second attribute refers to the cost of a second opinion (SECOP). In the status quo, patients must come up with 10 Euros per quarter for every additional physician they contact unless referred by the treating physician. In the alternative, one second opinion per quarter is free of charge. Therefore, this attribute has two levels.

Additional services provided by health insurers constitute the third attribute. The status quo is no particular services or information provided. However, when insurers are to offer contracts with new ways of providing care, consumers' demand for information quite likely increases. Therefore, the alternative scenario comprises a qualified patient counselor available on the telephone 24 hours per day (PHONE) for helping to organize medical care and to assess the seriousness of symptoms. Again, this attribute has two levels.

The fourth attribute revolves around incentives designed to limit moral hazard effects. Since the insured do not have to fully bear the financial consequences of an illness, they might be tempted to skim on preventive effort or opt for the more costly therapy (see Zweifel et al. (2009), Chapter 6). The status quo is characterized by the absence of any measures counteracting these moral hazard effects. The first alternative is a bonus option for no claims (BONUS). If no health care services (except recommended preventive and screening services) are utilized during a year, a premium rebate of 500 Euros is offered. The second alternative is a yearly deductible of 500 Euros (DEDUC), again with the exceptions just mentioned. Third, an insured who proves to have performed preventive activities recommended by the insurer would obtain a bonus such as reimbursement of pertinent fees or a free week-end at a spa (PREV).

Finally, increases or decreases of the annual health insurance contribution define the fifth attribute (PREM). Participants were asked to check their pay slip in order to calculate their personal share of the total contribution in Euros. The alternatives are increases and decreases of 200, 300, 400, and 500 Euros annually. The higher amounts

Attributes	**Attribute levels**	
	Status quo contract	Alternative contract
Physician choice	Free physician choice	Physician list
Second opinion	10 Euros fee without referral	10 Euros fee without referral
Phone counselor	No free phone counselor provided by insurer	Free phone counselor provided by insurer
Incentives	No bonus system	Bonus of 500 Euros for no claims
Contribution	Your current annual contribution (in Euros)	Reduction by 500 Euros annually
I opt for...	the current policy ☐	this alternative ☐

Table 4.3: Example of decision card (Germany)

seem unrealistic; however, the price attribute needs to be set in a way to cause respondents to sometimes move away from the status quo, generating information about their preferences. In total, this attribute has eight levels.

These five attributes and their levels combine to form scenarios that can be compared to the status quo. There is a total of 512 ($= 4^2 \cdot 2^2 \cdot 8^1$) combinations of attribute levels in the full factorial design, too many for an experiment. 24 choice sets of a hypothetical alternative combined with the status quo alternative were designed using a *D*-optimality algorithm that produces unbiased parameter estimates (see Carlsson and Martinsson (2003)).[4] The resulting scenarios were then randomly blocked into three sets with eight decisions each. This number was compatible with the maximum length of telephone interviews suggested by the marketing agency in charge on the one hand and the number of attributes found relevant on the other. Table 4.3 contains an example of a decision card.

The DCE was fielded in September 2005, involving 1,003 individuals of age 25 and older, all members of statutory health insurance. Subscribers to private health insurance were excluded because different attributes would have been relevant to them. Ten respondents never made a decision and were excluded, leaving 963 respondents in the data with 7,155 observed choices after deleting single observations without a decision. About 21 percent never switched from the status quo contract to a hypothetical al-

[4] The design was made using the Gosset software (www2.research.att.com)

ternative, while two percent always preferred the alternative. Testing the influence of non-movers revealed no significant changes in estimated WTP values.

4.5.2 Results for Germany

Choice of priors and estimated posterior distributions

Choices were analyzed using the hierarchical Bayes mixed logit model described in Section 4.3. The left panel of Table 4.4 contains estimates based on fixed (non-hierarchical) coefficients with the exception of the normally distributed constant, making them equivalent to random-effects (RE) estimates.[5] The negative estimated mean of CONST points to a preference for the current insurance contract but may also reflect the cost of decision making that causes the alternative to be valued less highly. Its high estimated standard deviation constitutes a first sign of preference heterogeneity, with 85 percent of respondents having a preference for the status quo contract. The remaining coefficients suggest that the three attributes of Managed Care (LIST, GATE, NETW) are negatively valued. The same is true of a deductible (DEDUC) and the price attribute (PREM). By way of contrast, a bonus for no claims (BONUS) as well as a bonus for preventive behavior (PREV) appear to contribute to utility on average, as expected.

The center and right panels of Table 4.4 display random-coefficient estimates based on the same prior distributions, with the exception of the deductible (DEDUC) and the price (PREM) attributes, where the prior can be a log-normal (L) or a Johnson's S_B distribution, respectively. Both sets of estimates reveal substantial preference heterogeneity. The columns labeled SH display shares of negative estimates for all assumed priors but the truncated normal, where shares of zero estimates are shown. For instance, according to the discussion of Section 4.5.1 a physician list (LIST) could be valued both positively or negatively by respondents. Assuming a normal prior to reflect this belief ($k = N$ in Table 4.4), one obtains a posterior distribution of coefficients pertaining to LIST with a share of 92 percent negative values. However, the remaining 8 percent like a physician list. They presumably value the fact that only physicians who

[5] The estimated distribution parameters are displayed in Table 4.10 of the Appendix.

satisfy the insurers' quality and cost criteria are admitted. About half of the sample is in favor and against gatekeeping (GATE) compared to free physician choice. Apparently, the restriction of choice of primary care provider inherent in LIST weighs more heavily than the channeling imposed by GATE. Joining a network (NETW) is valued negatively by 83 percent of respondents, reflecting the additional requirement that a participating specialist must be selected.

	Fixed coefficients				**Random coefficients**							
	RE				*L*				S_B			
	k	MN	SD	SH	k	MN	SD	SH	k	MN	SD	SH
LIST	F	-1.26	0.00	–	N	-2.58	1.82	0.92	N	-2.64	1.87	0.92
GATE	F	-0.39	0.00	–	N	-0.01	1.27	0.50	N	-0.04	1.29	0.51
NETW	F	-0.74	0.00	–	N	-1.44	1.50	0.83	N	-1.49	1.56	0.83
SECOP	F	0.28	0.00	–	T	0.92	1.46	0.55	T	0.79	1.35	0.59
PHONE	F	0.45	0.00	–	T	1.29	2.20	0.59	T	1.22	2.10	0.59
BONUS	F	1.25	0.00	–	T	2.39	1.73	0.12	T	2.38	1.76	0.13
DEDUC	F	-0.94	0.00	–	L	-65	1,483	1.00	S_B	-0.17	0.27	1.00
PREV	F	0.67	0.00	–	T	1.13	1.82	0.56	T	1.13	1.97	0.60
PREM	F	-0.36	0.00	–	L	-1.15	2.04	1.00	S_B	-0.10	0.13	1.00
CONST	N	-1.75	1.70	0.85	N	-4.24	3.61	0.88	N	-4.11	3.57	0.88
Sim-$\mathcal{LL}$:	-3,064.40				-2,878.90				-2,877.00			

Note: Simulated population means (MN) and standard deviations (SD) under assumed priors. For the random-effects logit, $k = F$ indicates that coefficients are kept fixed. Assumed priors $k(\beta_n)$ are normal (N), log-normal (L), truncated normal at zero from below (T), and Johnson's S_B. Share of population (SH) with negative coefficients for $k = N, L, S_B$ and zero coefficient (indifferent) for $k = T$.

Table 4.4: Posterior descriptives (Germany)

A second opinion free of charge (SECOP) and a phone counselor (PHONE) provided by the health insurer are assumed to have truncated normal (T) priors as discussed in Section 4.3. A share of 59 percent (55 percent, respectively) are found to be indifferent with regard to SECOP; this is also true of 59 percent with regard to PHONE. Although of equal magnitude, a bonus of 500 Euros for no claims (BONUS) and a deductible of 500 Euros (DEDUC) calls for different priors. In the first case, individuals who expect health care expenditure in the following year below 500 Euros stand to obtain a net gain by paying themselves and preserving their bonus. In the case of expenditure in excess of 500 Euros, the option value of the bonus is zero. This suggests a truncated normal distribution. Indeed, only about 13 percent of respondents are estimated to be indifferent regarding a bonus for no claims. In contrast, respondents would have to foot the bill up to the 500 Euros of the deductible under all circumstances. This fact precludes indifference with regard to the deductible option, ceteris paribus (note that the price attribute PREM is varied independently). It can be modeled by a log-normal (L) or S_B distribution.

The downside of the log-normal is that its long tail can cause implausible mean WTP values (see Hess et al. (2005)). In the center panel of Table 4.4, the implausible coefficient of -65.01 pertaining to DEDUC combined with an excessive standard deviation reflects this weakness. Therefore, an estimate derived from a S_B prior distribution with a lower bound at zero and an upper bound u (see Section 4.3) is displayed in the right panel of Table 4.4. Similar to Rigby and Burton (2006), we reduce the upper bound in an iterative process, resulting in $u = 30$.[6] The outcome is a posterior mean value of -0.17 for the coefficient of DEDUC.

The third incentive option, a bonus for preventive behavior (PREV), may be irrelevant for some individuals because they know that their lack of preventive effort will make them non-eligible for the bonus for sure. The truncated normal indicates that between 56 and 60 percent of respondents fall in this category.

The annual contribution (PREM) is the price attribute; it is negatively valued according to economic theory. In analogy to DEDUC, its (absolute) marginal utility is assumed to follow a log-normal or S_B prior distribution with an upper bound found at $u = 10$. This time, both alternatives yield plausible mean posterior values; however, the S_B specification fits the data slightly better than the log-normal.

Finally, now that the other parameters besides the constant allow for preference heterogeneity, the share of respondents who prefer their current health insurance contract increases from 85 to an estimated 88 percent.

[6] Models were compared using the simulated log-likelihood value for each model.

Willingness-to-pay estimates for Germany

From the three sets of coefficient estimates exhibited in Table 4.4, marginal WTP values can be derived. The left panel of Table 4.5 displays those obtained for the random-effects (RE) specification. They are consistently on the low side because they neglect the considerable skewness found in the individual-specific WTP estimates (see Figure 4.1). Generally, simulating WTP values using the population parameter estimates without conditioning on observed choices in the experiment can result in implausible WTP estimates. According to Greene et al. (2005), this problem can be mitigated by using individual-specific coefficients, conditioning on the respondents' observed choices. The center and right panels of Table 4.5 contain individual-specific estimates derived from the log-normal (L) and S_B specifications, respectively. For all attributes except DEDUC, the choice between the L and S_B specification does not matter. In the case of DEDUC (compared to no incentives, NOINCT), the WTP value in the L specification attains as much as -7,780 Euros (5^{th} percentile) for bearing a risk of no more than 500 Euros, which is clearly unrealistic. This makes the bounded S_B the preferred specification. Therefore, the S_B results shown in the right panel of Table 4.5 are discussed below.

		Individual-specific WTP values							
	RE	*L*				S_B			
Statistic	MN	MN	MD	5%	95%	MN	MD	5%	95%
LIST $^{a)}$	-348	-618	-359	-2,435	116	-717	-363	-2,910	145
GATE $^{a)}$	-107	-201	3	-1,624	414	-278	-0	-2,144	476
NETW $^{a)}$	-205	-210	-171	-1,341	766	-197	-166	-1,631	925
SECOP	77	149	0	0	744	141	0	0	731
PHONE	124	156	0	0	721	163	0	0	730
BONUS $^{b)}$	346	513	286	0	1,716	576	280	0	2,086
DEDUC $^{b)}$	-260	-3,776	-122	-7,780	-2	-513	-123	-2,458	-2
PREV $^{b)}$	184	463	0	0	2,195	586	0	0	2,632
CONST (SQ=0)	-482	-567	-535	-2,633	1,211	-585	-523	-3,299	1,199

Note: $^{a)}$ versus FREE, $^{b)}$ versus NOINCT; The descriptives of the WTP values are displayed in Euros per year. Statistics are mean (MN), median (MD), and 5^{th} and 95^{th} percentiles.

Table 4.5: Individual-specific WTP values (Germany)

The three attributes typical of Managed Care options reveal neither a positive mean nor a positive median for the WTP values. Judging by the medians, the highest compensation is asked for accepting a physician list (LIST), amounting to 363 Euros per year, followed by participation in a physician network (NETW) with 166 Euros and by the gatekeeping option (GATE) with no compensation asked. This is intuitive because LIST constitutes the harshest restriction whereas GATE and NETW apply only when the need for specialist care arises, which is less likely. The median values are closer to zero than the means throughout, while the negative 5^{th} percentiles are much further away from zero than the positive 95^{th}. All of this points to skewness towards strongly negative values. This impression is confirmed by the top three panels of Figure 4.1, which show the distribution of individual-specific WTP values among the sampled population.

The two attributes SECOP and PHONE with their truncated normal priors do not allow for negative WTP values. On average, obtaining a second opinion free of charge is valued at 141 Euros and an extra phone service provided by the health insurer, at 163 Euros per year.[7] Therefore, neither of these offers would be sufficient to make up for imposing one of the three Managed Care restrictions. In addition, the median value is zero in both cases, pointing to skewness towards positive WTP values (see the pertinent panels of Figure 4.1).

The first two incentive attributes (BONUS, DEDUC), are of particular interest. One could argue that a bonus for no claims amounting to 500 Euros exposes the insured to the same risk as a fixed deductible of 500 Euro. In the former case, an insured does not claim expenses up to 500 Euros because he or she would not be eligible for the 500 Euro bonus anymore, making a loss. Therefore, the insured pays the first 500 Euros out of pocket, exactly as in the case of a 500 Euro deductible. However, this argument overlooks the fact that a bonus option permits consumers to separate two losses in time that occur simultaneously under the deductible, viz. the health loss and

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[7] The distribution parameters for these two attributes are not statistically different from zero. Even though the truncated normal is best from a microeconomic perspective, we estimated additional models with different priors. If a normal distribution is assumed, both mean and variance differ from zero. The mean WTP for SECOP is 176 Euros and 179 Euros for PHONE.

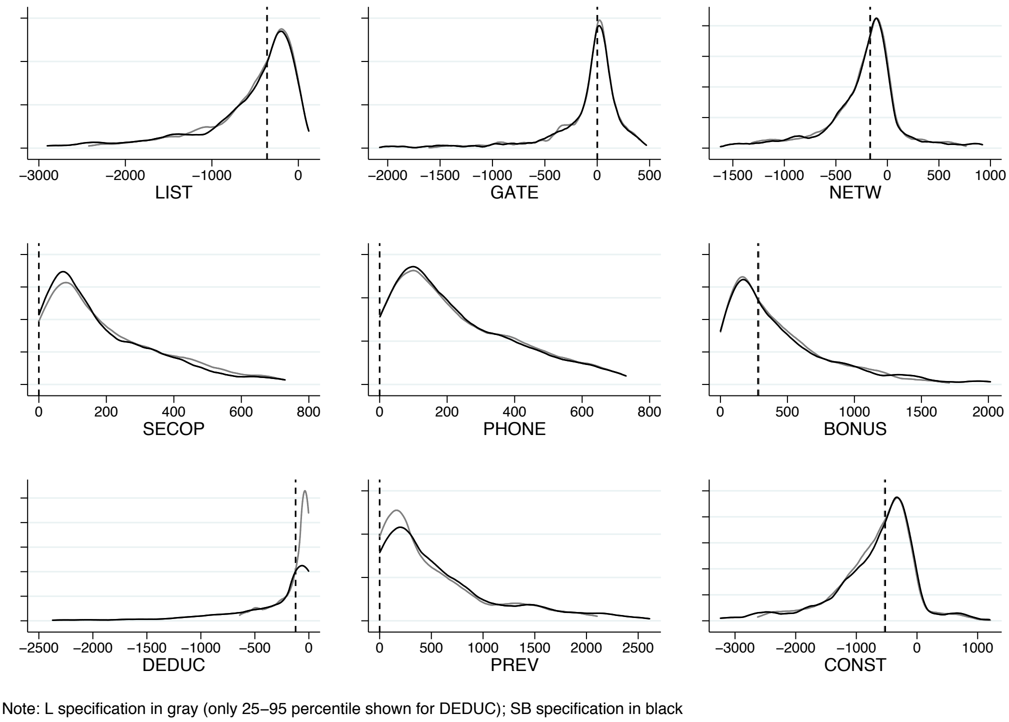

Figure 4.1: Kernel densities of individual-specific WTP values (Germany)

the financial loss caused by the cost of medical care. With a deductible, these two losses are perfectly correlated during a quarter (say). With a bonus option, they are separated in time because consumers can sacrifice their bonus to obtain full coverage, shifting the financial loss to later in the guise of a higher premium (Zweifel and Waser (1992), Chapter 3). Table 4.5 shows that respondents value the bonus option favorably with a mean WTP of 576 Euros, while resisting a deductible of the same amount to the tune of 513 Euros. However, values in excess of 500 Euros are not rational in view of a positive probability of incurring health care expenditure of less than 500 Euros. The median values are in the acceptable range, indicating a willingness to pay of 280 Euros for a no claims bonus but a compensation required of 123 Euros for the deductible.

The bonus for preventive effort (PREV) again cannot have negative WTP values due to its truncated normal prior. The mean is a high 586 Euros annually, which implies that respondents value a free weekend at the spa at least as high as this. At the same time, the median WTP is zero. The pertinent panel of Figure 4.1 again exhibits a marked degree of skewness.

As to the constant (CONST), the negative mean WTP indicates that respondents on average would have to be compensated by 585 Euros anually to accept a deviation from their current (status quo) contract. This time, the median does not differ much (523 Euros) but conceals considerable skewness towards negative values (see the last panel of Figure 4.1).

4.6 The choice experiment for the Netherlands

4.6.1 Study design for the Netherlands

A second DCE was performed in the Netherlands in May 2006, after a major reform. By March 2006, every citizen had to have explicitly chosen a health insurance contract, with a great deal of information provided by the government through flyers and the media. Therefore, respondents had borne the (lowered) cost of decision making associated with the choice of a health insurance policy. While most of the attributes were the same as in Germany, two adjustments had to be made. First, the status quo for physician choice and incentives had to be defined differently. Already before the reform of 2006, physician choice had been constrained in that patients were obliged to contact a gatekeeping physician first. Therefore, one of the alternatives in the experiment became free physician choice (FREE). Second, in the pretest a second opinion free of charge turned out to be far less important than expeditious (defined to be within four weeks in the DCE) access to hospital care (HOSP), waiting for hospital treatment being a hotly debated topic in the Netherlands at the time. Therefore, the HOSP option was included as an alternative. Moreover, there was already a bonus for no claims under the status quo, attaining a maximum of 255 Euros annually. The design of the DCE is summarized in Table 4.6. Similar to the experiment in Germany, the number of alternatives was reduced with a D-optimal algorithm (see Section 4.5.1).

Attributes	**Attribute levels**
Physician choice [a)]	Gatekeeping versus physician list (LIST, ±),free physician choice (FREE, ±), network (NETW, ±)
Hospital access [b)]	Current waiting time versus waiting time less than four weeks (HOSP, 0^+)
Additional services	No particular services or information provided versus counselor available on the telephone (PHONE, 0^+)
Incentives [c)]	Bonus of max. 255 Euros for no claims versus no incentives (NOINCT, 0^-), deductible of 500 Euro per year (DEDUC, −), bonus for preventive behavior (PREV, ±)
Contribution	Respondent's current annual premium (in Euro) versus changes of ±200, ±300, ±400, and ±500 Euros (PREM, −)

Note: [a)] different status quo (Germany = free physician choice), [b)] attribute replaces second opinion, [c)] different status quo (Germany = no bonus) and bonus for no claims is max. 225 Euros (Germany, 500 Euros).

Table 4.6: Attributes and attribute levels (Netherlands)

In the DCE for the Netherlands, 763 respondents took part in the main survey, of which only five never made a decision, leaving 758 respondents with a total of 5,976 observed choices. About every fifth respondent (20.3 percent) never chose a hypothetical alternative while 1.3 percent always preferred the alternative to the status quo contract. Similar to the experiment in Germany, excluding non-movers would not have affected the estimated WTP values.

4.6.2 Results for the Netherlands

Choice of priors and estimated posterior distributions

In the left panel of Table 4.7, the RE estimates suggest that free physician choice (FREE) is positively valued in comparison to gatekeeping in the status quo. Having guaranteed hospital access within four weeks (HOSP) also contributes to utility, which may be true of dropping the bonus for no claims (NOINCT) as well. A deductible of 500 Euros (DEDUC) is resisted, as is an increase in premium (PREM), both as expected. The negative mean of the constant (CONST) in combination with its high standard deviation provides a first indication of status quo preference as well as preference heterogeneity.

For the random-coefficient estimates displayed in the center and right panels of Table 4.7, the priors were chosen in analogy to the DCE in Germany, with four modifications. First, guaranteed hospital access within four weeks (HOSP, replacing SECOP) can hardly induce a loss of utility, calling for a truncated normal. Second, dropping the bonus for no claims amounts to the loss of an option with non-negative value (see the analogous argument in Section 4.5.2 for Germany) and is modeled using a truncated normal. Third, the bonus for preventive behavior (PREV) has to be compared to the existing bonus for no claims (rather than no incentives at all, as in Germany). Therefore, respondents can be in favor of one or the other type of bonus, suggesting a normal prior for PREV. Finally, in the case of DEDUC the upper bound for the S_B distribution was found to be best at $u = 50$, while the upper bound for PREM remains at $u = 10$. The choice between the log-normal (L) and the S_B prior hardly matters except for DEDUC, where the L specification results in a posterior mean estimate that is clearly implausible. Moreover, the S_B alternative yields a higher simulated log-likelihood value. Therefore, the S_B estimates are discussed below.

A change from the gatekeeping contract to free physician choice is positively valued by an estimated 72 percent of respondents, whereas accepting a physician list (LIST) would be welcomed by 27 percent only. If gatekeeping were to be complemented by limiting the choice of specialists to those participating in the network (NETW), this would trigger a negative WTP among 76 percent of respondents. The 24 percent who prefer the network may expect improved communication among participating physicians as a benefit. Guaranteed hospital access within four weeks (HOSP) is valued positively by 31 percent of respondents only, a phone counselor provided by the insurer (PHONE), by 50 percent. Giving up the bonus for no claims option (NOINCT) is resisted by 20 percent of the sample. Indeed, estimated means and variances of HOSP, PHONE, and NOINCT do not differ significantly from zero (see Table 4.11 of the Appendix). About two-thirds (68 percent) of all respondents like the bonus for preventive behavior

	Fixed coefficients				**Random coefficients**							
	RE				L				S_B			
	k	MN	SD	SH	k	MN	SD	SH	k	MN	SD	SH
FREE	F	0.36	0.00	–	N	0.84	1.38	0.27	N	0.82	1.41	0.28
LIST	F	-0.69	0.00	–	N	-0.81	1.37	0.72	N	-0.83	1.34	0.73
NETW	F	-0.43	0.00	–	N	-0.94	1.50	0.74	N	-1.17	1.64	0.76
HOSP	F	0.35	0.00	–	T	1.04	2.05	0.67	T	1.48	3.07	0.69
PHONE	F	0.30	0.00	–	T	0.97	1.48	0.52	T	1.52	2.23	0.50
NOINCT	F	0.02	0.00	–	T	-0.50	1.29	0.78	T	-0.81	2.20	0.80
DEDUC	F	-2.17	0.00	–	L	-326	4,416	1.00	S_B	-0.34	0.34	1.00
PREV	F	-0.04	0.00	–	N	-1.13	2.68	0.66	N	-1.35	2.94	0.68
PREM	F	-0.52	0.00	–	L	-1.43	2.25	1.00	S_B	-0.15	0.17	1.00
CONST	N	-1.26	1.49	0.80	N	-2.46	2.10	0.88	N	-2.67	2.24	0.88
Sim-$\mathcal{LL}$:	-2,536.90				-2,384.60				-2,381.60			

Note: Simulated population means (MN) and standard deviations (SD) under assumed priors. For the random-effects logit, $k = F$ indicates that coefficients are kept fixed. Assumed priors $k(\beta_n)$ are normal (N), log-normal (L), truncated normal at zero from below (T), and Johnson's S_B. Share of population (SH) with negative coefficients for $k = N, L, S_B$ and zero coefficient (indifferent) for $k = T$.

Table 4.7: Posterior descriptives (Netherlands)

(PREV) less than the current bonus for no claims. Finally, negative coefficients of the constant have a frequency of 88 percent, indicating that a great majority prefers the status quo contract to the alternatives presented.

Willingness-to-pay estimates for the Netherlands

The left panel of Table 4.8 displays the WTP estimates derived from the RE specification. Neglecting the skewness present in the posterior distributions (see Figure 4.2), they are likely underestimated. By way of contrast, the WTP values shown in the center and right panel are derived from the estimated individual-specific coefficients. In view of entirely implausible estimates based on the L specification, discussion focuses on the S_B variant (see the right panel of Table 4.8). One notes first that returning from gatekeeping (GATE) to free choice of physician (FREE) would trigger a mean WTP value of 311 Euros with a much lower median value of 59 Euros, while changing to a physician list (LIST) would require a mean compensation to the tune of 150 Euros per year (median 63 Euros). However, to accept the most restrictive network option (NETW), the Dutch insured ask on average for an annual premium reduction of only 17 Euros. Here, the median WTP amounts to 73 Euros per year, indicating a cumulation of respondents who are but mildly opposed to participating in a network also restricting their choice of specialist.

	Individual-specific WTP values								
	RE	*L*				S_B			
Statistic	MN	MN	MD	5%	95%	MN	MD	5%	95%
FREE [a)]	69	192	68	-352	1,065	311	59	-471	1,491
LIST [a)]	-134	-151	-68	-869	441	-150	-63	-1,212	537
NETW [a)]	-83	-80	-66	-813	480	-17	-73	-948	785
HOSP	67	93	0	0	509	67	0	0	350
PHONE	57	107	0	0	501	112	0	0	512
NOINCT [b)]	4	-29	0	-194	0	-26	0	-168	0
DEDUC [b)]	-419	-17,503	-1,223	-60,502	-38	-2,253	-905	-8,936	-38
PREV [b)]	-7	-279	-87	-2,143	775	-430	-106	-3,198	971
CONST	-243	-362	-244	-1,480	265	-353	-240	-1,888	412

Note: [a)] versus GATE, [b)] versus BONUS; The descriptives of the WTP values are displayed in Euros per year. Statistics are mean (MN), median (MD), and 5^{th} and 95^{th} percentiles.

Table 4.8: Individual-specific WTP values (Netherlands)

On average, guaranteed hospital access (HOSP) is valued at 67 Euros annually. The offer of a phone counselor (PHONE) has a mean WTP of 112 Euros annually. Abolishing the bonus for no claims (NOINCT) would require a mean compensation of 26 Euros. However, these three WTP values reflect the influence of few respondents with very high positive (negative) WTP values, while the median WTP is zero throughout (see the panels of Figure 4.2 pertaining to HOSP, PHONE, and NOINCT). With reference to the bonus for no claims in particular, neither the mean of the random-coefficient model (see Table 4.10 in the Appendix) nor the coefficient in the random-effects model (Table 4.12) is statistically different from zero. Therefore, Dutch health insurers could stop providing the bonus for no claims without having to reduce their annual premium. In stark contrast, replacing it by a deductible of 500 Euros per year

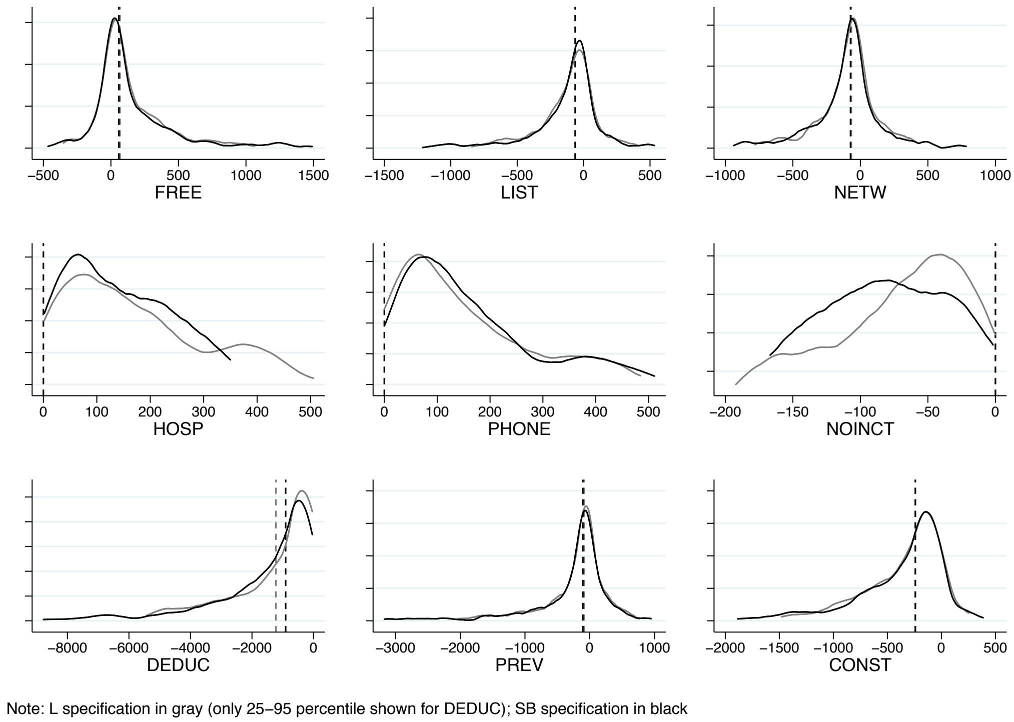

Figure 4.2: Kernel densities of individual-specific WTP values (Netherlands)

(DEDUC) would have to be compensated by an average of no less than 2,253 Euros. This value is implausible, however, because consumers cannot lose more than 755 Euros due to this change. This sum applies to individuals who are eligible for the bonus at the beginning of the year (loss of 255 Euros) but then have to pay up to the full amount of the deductible due to high current health care expenditure (loss of 500 Euros). For all others, a maximum WTP of 500 Euros for avoiding the deductible is predicted. Even the median of 905 Euros is almost twice this maximum value.

Accepting a change from the current bonus for no claims (BONUS) to a bonus for preventive behavior (PREV) has to be compensated on average by 430 Euros. The median of 106 Euros reflects the fact that some respondents ask for a very high compensation (3,198 Euros at the 5^{th} percentile, see Table 4.8) which is implausible. Respondents apparently viewed themselves as being exposed to a financial risk (loss of the bonus for prevention) in addition to the loss of the bonus for no claims, resulting in a cumulation of risks (see the argument in Section 4.5.2).

Finally, the status quo preference represented by the constant (CONST) amounts to an estimated mean of 353 Euros. As can be gleaned from the last panel of Figure 4.2, this value reflects the presence of a few respondents who would require very high compensation for deviating from the status quo.

4.7 Germany and the Netherlands compared

In this section, a comparison between the two DCEs is attempted. One motivation is to detect similarities and differences in preferences between the two countries with regard to health insurance. An additional motivation, however, concerns the impact of the 2006 reform in the Netherlands. Recall that citizens were obliged to specifically select an insurance policy. Therefore, they had already borne the cost of decision making associated with the choice at the time the DCE was fielded. As a likely consequence, Dutch respondents might be less resistant to consider an alternative to the status quo than their German counterparts.

Such a comparison rests on several assumptions. In particular, calculated WTP values must be related in the same way to the latent preference structure in the two DCEs (reliability), and for validity, they must not be confounded by unobserved influences (see Telser and Zweifel (2007) for details). Finally, since comparison will be in terms of distributions of individual-specific WTP values without conditioning for observable covariates, the two samples should not differ strongly with regard to determinants of WTP such as age and income.

While a systematic test of these conditions is beyond the scope of this paper, there are several indications suggesting that they might be satisfied to an approximation. Concerning reliability, the probability of never choosing the alternative is found to positively depend on age, female sex, and low income in both samples, with similar coefficients (Becker-Leukert et al. (2007), Appendix Tables A.6.1 and A.6.2). Validity is helped by the fact that the two DCEs were conducted only six months apart and in neighbouring countries with a similar GDP growth record at the time (see OECD

(2010b)), which makes a differential impact of the business cycle unlikely. Finally, major determinants of WTP for health insurance were shown to have comparable values in the two samples (see Table 4.1).

However, the differences in status quo makes an additional assumption necessary. The objective is to estimate the WTP of Dutch respondents for a transition from a counterfactual status quo of free physician choice (the actual status quo in Germany) to the Managed Care options LIST and NETW. For this to be possible, the marginal rates of substitution between these two attributes and the price attribute (PREM) must be constant. Then, the known WTP for the transition from GATE to FREE is equal to the WTP for a transition from FREE to GATE. In addition, the WTP for a change from FREE to LIST amounts to the sum of WTP values for a counterfactual change from FREE to GATE and from GATE to LIST. Referring to the fixed WTP values from the *RE* specification for simplicity, the entry for LIST vs FREE for the Netherlands (-203) in Table 4.9 is the sum of the (negative of) FREE vs GATE (-69) and LIST vs GATE (-134) taken from Table 4.8. In analogy, accepting a network contract (NETW

	Germany					**Netherlands**				
	RE	S_B				*RE*	S_B			
Statistics	MN	MN	MD	5%	95%	MN	MN	MD	5%	95%
LIST $^{a)}$	-348	-717	-363	-2,910	145	-203	-460	-137	-2,166	448
GATE $^{a)}$	-107	-278	0	-2,144	476	-69	-311	-59	-1,491	471
NETW $^{a)}$	-205	-197	-166	-1,631	925	-152	-328	-128	-2,219	816
PHONE	124	163	0	0	730	57	112	0	0	512
CONST $^{b)}$	-482	-585	-523	-3,299	1,199	-243	-353	-240	-1,888	412

Note: $^{a)}$ versus FREE, $^{b)}$ with SQ=0; Entries for Germany taken from Table 4.5 (left and right panel). The *RE* entries for the Netherlands are taken from Table 4.8 (left panel) and are adjusted for difference in status quo (see text). The S_B entries aresummary statistics of adjusted individual-level values.

Table 4.9: Comparison of German and Dutch individual-specific WTP values

vs FREE) requires a premium reduction of 152 Euros ($= -69 - 83$), the sum of FREE vs GATE (-69) and NETW vs GATE (-83) in Table 4.8.

Adjustment of the WTP values from the S_B specification is performed in the same way (see Table 4.9) except that summation concerns individual-specific values, causing entries in Table 4.9 to deviate from the pertinent sum of WTP values in Table 4.8 (e.g., $-460 \neq -311 - 150$).[8] The two remaining attributes that can be compared are a free phone counselor (PHONE) and the constant (CONST), measuring the preference for or against the status quo contract. These two attributes do not require a recalculation and can be compared directly. This is not possible for BONUS, NOINCT, DEDUC, and PREV because they differ not only with regard to the status quo but also the status quo level.

Focusing on the median WTP values which are less sensitive to outliers, one finds the same preference order in both countries for Managed Care attributes if compared to free physician choice. A physician list (LIST) has to be compensated most, followed by joining a network (NETW), and gatekeeping (GATE). However, the median compensation asked in Germany for accepting a physician list (363 Euros) is more than 2.5 times the value in the Netherlands (137 Euros) indicating that physician lists are more strongly opposed in Germany than the Netherlands. With regard to a network, the multiplier falls to 1.3 (166 vs 128 Euros). In contrast, accepting gatekeeping and giving up free physician choice does not have to be compensated in Germany but with 59 Euros in the Netherlands. This might be an indication that experience with gatekeeping need not reduce resistance against it. In both countries, more than 50 percent of respondents are not willing to pay for PHONE, resulting in a median WTP of zero.[9] The median compensation asked for changing away from the current contract amounts to 523 Euros in Germany but only 240 Euros in the Netherlands. In addition, the difference between the 5^{th} and 95^{th} percentile is as high as 4,498 Euros ($= 1,199 + 3,299$)

8 S_B estimates are used for the comparison even though different upper bounds for the prior distribution of DEDUC are assumed in the two DCEs (see Sections 4.5.2 and 4.6.2). However, Tables 4.4 and 4.7 show that a change from a log-normal to a S_B prior for DEDUC does not affect the remaining estimates so that the differences in WTP values between German and Dutch respondents can hardly arise due to this difference in upper bounds.

9 On average, the WTP is higher in Germany with 163 Euros compared to 112 Euros in the Netherlands. These mean values are on the high side, especially if one considers the 95^{th} percentiles of 1,199 and 412 Euros, respectively.

in Germany compared to 2,300 Euros ($= 412 + 1,888$) in the Netherlands. Since there is no sign of systematically greater preference heterogeneity in Germany (see the panels for LIST, NETW, PHONE, DEDUC, and PREV in Figures 4.1 and 4.2), one may conclude that the necessity to choose in combination with the information campaign of the Dutch government had the effect of reducing status quo preference.

4.8 Conclusions

This contribution seeks to measure preferences for health insurance in two countries and to compare them, using two Discrete Choice Experiments (DCEs) performed in Germany (with no effective reform, but ongoing discussions about the introduction of Managed Care-type insurance contracts) and in the Netherlands right after the 2006 reform which made citizens explicitly choose their health insurance. Bayesian mixed logit estimation was applied to derive individual-specific willingness-to-pay (WTP) values, with the prior distribution selected to reflect constraints suggested by economic theory. In view of the considerable skewness found, emphasis is on median rather than average values. In the case of Germany, where free physician choice characterizes the status quo, the three Managed Care-type features included in the DCE (a physician list established by the health insurer, gatekeeping, and adherence to a physician network) must be compensated with up to 363 Euros annually. As to new financial incentives, resistance against a 500 Euro annual deductible could be overcome by a 123 Euro reduction in premium, whereas a bonus for no claims in the same amount triggers a WTP of 280 Euros. However, preference heterogeneity is especially marked with regard to these two attributes.

In the case of the Netherlands, the status quo was gatekeeping in combination with a bonus for no claims of up to 255 Euros per year. Here, a return to free physician choice would have an estimated WTP of 59 Euros; conversely, transition to a physician list or network would have to be compensated with 63 Euros. A deductible of 500 Euros is resisted at the tune of 905 Euros (the random-effects logit estimate is 419), an implausible value due to an extreme degree of preference heterogeneity. By way of contrast, a possible abolishment of the bonus for no claims would meet with indifference.

A comparison of the two countries reveals that compared to free physician choice, the three Managed Care-type features included in the DCE require compensation in terms of a premium reduction. The same is true of a 500 Euro deductible. A quantitative comparison requires assumptions regarding validity, reliability, and local constancy of marginal rates of substitution for adjustment of the status quo in the Netherlands to a counterfactual free choice of physician. On these assumptions, acceptance of a physician list would have to be compensated most in both countries, followed by adherence to a network and gatekeeping. The one salient difference is status quo preference, which demands much less compensation to be overcome in the Netherlands than in Germany. A plausible explanation is that the need to explicitly choose a contract in combination with the information campaign launched by the Dutch government in the context of the 2006 reform lowered the cost of decision making with regard to health insurance to Dutch citizens.

This study is subject to several limitations. The first and most important is the hypothetical nature of choices made by respondents. Even in the absence of privacy constraints, it would have been extremely difficult to link stated choices to future actual ones because insurance policies having the selected attributes were not becoming available. For the same reason, associating stated choices with past ones would not be informative. Another issue is the selection of relevant attributes. Pretests can provide qualitative indications only, which may not be vindicated by estimated WTP values in the actual DCE. In addition, an attribute may be relevant in one DCE (e.g. rapid access to hospital services in the Netherlands) but not in the other. Comparison is limited to the overlapping attributes, whose WTP values may however depend on the level of the left-out ones. More generally, these values could be influenced by unmeasured determinants such as the political agenda and the economic climate in the respective country. To this must be added the (known) difference in the status quo.

However, these limitations are unlikely to invalidate the major finding of this study, a resistance of citizens against limitations of physician choice. One might have expected that Dutch respondents, having already adjusted to gatekeeping, would be indifferent towards adherence to a network that also limits choice of specialists. The available evidence does not support this notion; indeed, the similarity between the Dutch WTP values and their German counterparts is striking. On the other hand, the Dutch reform in 2006 makes a difference in that it seems to have mitigated status quo preference and hence resistance to future changes in health insurance.

Appendix

	L-**Model**					S_B-**Model**				
	k	Mean		Variance		k	Mean		Variance	
LIST $^{a)}$	N	-2.59	(0.33)	3.29	(1.18)	N	-2.65	(0.35)	3.47	(1.28)
GATE $^{a)}$	N	-0.01	(0.28)	1.62	(0.60)	N	-0.04	(0.31)	1.67	(0.63)
NETW $^{a)}$	N	-1.44	(0.25)	2.25	(0.81)	N	-1.48	(0.27)	2.44	(0.90)
SECOP	T	-0.33	(0.97)	7.31	(6.40)	T	-0.63	(0.85)	7.25	(5.26)
PHONE	T	-0.97	(1.32)	18.97	(14.98)	T	-0.98	(1.25)	17.53	(11.81)
BONUS $^{b)}$	T	2.28	(0.28)	3.70	(1.75)	T	2.26	(0.28)	3.89	(1.77)
DEDUC $^{n,b)}$	L	-0.38	(0.65)	9.57	(6.30)	S_B	-3.75	(0.54)	11.91	(5.63)
PREV $^{b)}$	T	-0.47	(1.32)	11.48	(11.12)	T	-0.99	(2.15)	15.61	(18.53)
PREM $^{n,b)}$	L	-0.60	(0.09)	1.48	(0.20)	S_B	-2.83	(0.10)	1.97	(0.30)
CONST $^{c)}$	N	-4.24	(0.42)	13.04	(2.49)	N	-4.11	(0.44)	12.79	(2.56)

Notes: Standard deviations are displayed in parentheses. Assumed priors $k(\beta_n)$ are N normal, L log-normal, T normal truncated at zero from below, and Johnson's S_B. $^{a)}$ status quo is free physician choice, $^{b)}$ status quo is no bonus system, $^{c)}$ status quo = 0, $^{n)}$ for negative value of coefficient.

Table 4.10: Estimated distribution parameters (Germany)

	***L*-Model**					**S_B-Model**				
	k	Mean		Variance		k	Mean		Variance	
LIST $^{a)}$	N	-0.81	(0.32)	1.85	(0.75)	N	-0.83	(0.38)	1.77	(0.70)
FREE $^{a)}$	N	0.85	(0.25)	1.91	(0.75)	N	0.82	(0.27)	1.99	(0.78)
NETW $^{a)}$	N	-0.94	(0.33)	2.26	(0.96)	N	-1.16	(0.38)	2.69	(1.15)
HOSP	T	-2.02	(2.02)	22.14	(27.96)	T	-3.76	(4.01)	56.00	(64.42)
PHONE	T	-0.16	(0.88)	6.99	(5.38)	T	-0.01	(0.94)	14.68	(15.25)
NOINCT $^{n,b)}$	T	-3.08	(1.80)	15.56	(14.18)	T	-5.99	(3.89)	51.37	(49.78)
DEDUC $^{n,b)}$	L	2.32	(0.46)	7.21	(4.17)	S_B	-1.39	(0.47)	7.98	(3.89)
PREV $^{b)}$	N	-1.13	(0.51)	7.24	(2.95)	N	-1.35	(0.60)	8.68	(3.61)
PREM $^{n)}$	L	-0.27	(0.10)	1.27	(0.28)	S_B	-2.40	(0.14)	2.25	(0.82)
CONST $^{c)}$	N	-2.46	(0.33)	4.40	(1.19)	N	-2.67	(0.42)	5.02	(1.51)

Notes: Standard deviations are displayed in parentheses. Assumed priors $k(\beta_n)$ are N normal, L log-normal, T normal truncated at zero from below, and Johnson's S_B. $^{a)}$ status quo is free physician choice, $^{b)}$ status quo is no bonus system, $^{c)}$ status quo = 0, $^{n)}$ for negative value of coefficient.

Table 4.11: Estimated distribution parameters (Netherlands)

	Germany					**Netherlands**				
	Mean		Variance		WTP	Mean		Variance		WTP
LIST	-1.26	(0.11)	–	–	-348	-0.69	(0.12)	–	–	-134
GATE	-0.39	(0.10)	–	–	-107	–	–	–	–	–
FREE	–	–	–	–	–	0.36	(0.11)	–	–	69
NETW	-0.74	(0.11)	–	–	-205	-0.43	(0.12)	–	–	-83
SECOP	0.28	(0.08)	–	–	77	–	–	–	–	–
HOSP	–	–	–	–	–	0.35	(0.09)	–	–	67
PHONE	0.45	(0.08)	–	–	124	0.30	(0.09)	–	–	57
BONUS	1.25	(0.10)	–	–	346	–	–	–	–	–
NOINCT	–	–	–	–	–	0.02	(0.10)	–	–	4
DEDUC	-0.94	(0.11)	–	–	-260	-2.17	(0.13)	–	–	-419
PREV	0.67	(0.14)	–	–	184	-0.04	(0.15)	–	–	-7
PREM	-0.36	(0.01)	–	–	–	-0.52	(0.02)	–	–	–
CONST	-1.75	(0.12)	2.91	(0.23)	-482	-1.26	(0.13)	2.23	(0.22)	-243

Notes: Standard deviations are displayed in parentheses. While all attributes have fixed coefficients CONST has an assumed normal prior.

Table 4.12: Estimated distribution parameters (random-effects specification)

GENERIC SUBSTITUTION, FINANCIAL INTERESTS, AND IMPERFECT AGENCY

BY
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SUMMARY

Policy makers around the world seek to encourage generic substitution. In this paper, the importance of prescribing physicians' imperfect agency is tested using the fact that some Swiss jurisdictions allow physicians to dispense drugs on their own account (physician dispensing, PD) while others disallow it. We estimate a model of physician drug choice with the help of drug claim data, finding a significant positive association between PD and the use of generics. While this points to imperfect agency, generics are prescribed more often to patients with high copayments or low incomes.

Chapter 5

Generic Substitution, Financial Interests, and Imperfect Agency

5.1 Introduction

Policy makers around the world seek to encourage generic substitution (i.e. the replacement of brand-name by generic drugs) in an attempt to reduce the pharmaceutical bill. In the United States for instance, several state policies promote the use of generic products by Medicaid beneficiaries [CMS (2004)]. Similar initiatives exist in Germany [Leutgeb et al. (2009)], Sweden [Andersson et al. (2007)], Switzerland [Decollogny and Ruggli (2006)], and Japan [Matsuda (2008)]. To be successful, these initiatives must be aligned with prescribing physicians' (or pharmacists') incentives. Generic substitution not only requires effort and time on the part of these professionals but also entails the risk of meeting with patient resistance. Three components of prescribers' utility can work to overcome resistance against generic substitution. First, prescribers may earn higher contributions to income from generic than from brand-named drugs. Second, acting as agents by taking patients' total (rather than merely health-related) utility into account, physicians are predicted to prescribe the generic if the savings accruing to the patient are important enough. Third, in view of public concern about growing health care expenditure, cost savings accruing to insurers might motivate physicians to prescribe lower-priced generic drugs.

In this context, evidence from Switzerland is of considerable interest. In some Swiss jurisdictions (cantons), physicians are allowed to dispense drugs to their patients on their own account. This setting will be referred to as 'physician dispensing' (PD) in the remainder of this paper.[1] In the remaining jurisdictions, physicians are obliged to let a pharmacy fill their prescriptions. Thus, both the PD and the non-PD (i.e. pharmacy-based) setting can be observed under otherwise very similar conditions. PD may well affect generic substitution provided physicians act as imperfect agents and given that generic drugs differ from brand-name drugs in terms of their contribution to physician income.

Retail prices paid by patients are regulated to be equal for all drug sellers (physicians and pharmacies). The contribution to the sellers' income, then, is the difference between manufacturers' prices and retail prices. Concerning manufacturers' prices, there is room for discounts and individual bargaining, causing the effective contributions to income to be unknown. However, several factors indicate that contributions to physician income can be higher for generic than for brand-name drugs. First, many generic alternatives are usually available for the same brand-name drug, leading to fierce competition for access to prescribers among generic producers. Second, the retail prices of generic drugs are markedly higher in Switzerland than in comparable European countries, suggesting that generic producers have ample leeway for rebates to prescribers.[2] Third, while there is no public information about such rebates, interviews conducted with Swiss wholesalers and physicians support the notion that prescribers derive more income from generic than brand-name drugs.

The remainder of this article is structured as follows. Section 5.2 contains a short review of the literature. Section 5.3 describes the institutional setting. Section 5.4

1 PD is the counterpart of prescribing pharmacists, who exist e.g. in the case of refills in the United States, Canada, the United Kingdom, and New Zealand [Emmerton et al. (2005)]. In both cases, the prescriber and the dispenser is one and the same person or institution, respectively.

2 The prices for brand-name drugs are also higher in Switzerland, but the markups for physicians are smaller (see Section 5.3.2).

presents a theoretical model of physician prescribing behavior, along with a set of testable hypotheses. The empirical strategy used for hypothesis testing is explained in Section 5.5. Section 5.6 contains a description of the data. Results are shown in Section 5.7, while Section 5.8 rounds off with a summary and conclusions.

5.2 Literature review

To keep this survey concise, there will be no discussion of research into physician behavior in general. Rather, focus is on prescribing behavior. An early pertinent study is the one by Morton-Jones and Pringle (1993), who compare prescription patterns of PD and non-PD providers in the UK, finding that the share of generic drugs is lower in the PD segment. Liu et al. (2009) analyze the choice between generic and brand-name drugs in Taiwan, where PD is the dominant mode. According to them, financial incentives markedly influence this choice. Specifically, providers on a global budget are more likely to prescribe generic drugs than those reimbursed fee-for-service. Moreover, cheaper brand-name drugs (which in Taiwan contribute less to physician income, as in Switzerland) are more often replaced by generics than expensive ones. Using Japanese data on hypertension drug sales, Iizuka (2007) concludes that markups available to physicians significantly influence drug choice. However, he also finds that physicians take the cost of the drug to their patients into account. Finally, the 2000 reform in South Korea provides an interesting natural experiment. At that time, both drug dispensing by physicians and drug prescribing by independent pharmacists were outlawed. Descriptive statistics presented by Kim and Ruger (2008) indicate a marked increase in the market share of high-price drugs in the year following the reform. However, the longer-term effects of the reform could not be assessed on the basis of their data.

Papers that are methodically related to ours are Hellerstein (1998), Lundin (2000), and Hellstrom and Rudholm (2010). They analyze the choice between generic and brand-name drugs in a non-PD setting. Hellerstein argues that physicians bear higher information costs when prescribing generic rather than brand-name drugs because they have more personal experience with the brand-name than with the generic drugs. Contrary to the hypothesis of perfect agency, she finds that prescription is not influenced by patients' insurance status and hence financial burden. However, physicians who predominately treat patients in capitated or Health Maintenance Organization (HMO) settings are more likely to prescribe generics (controlling for individual insurance status). Her panel data specification also shows that a large part of the unexplained variance is physician-specific, which also holds true of Lundin's contribution. Interestingly, Lundin argues that physicians may want to honor R&D expenditure and pioneering effort by innovators, causing them to bear added psychic cost when prescribing a generic. He finds evidence that higher cost to the patient through copayment increases the probability of generics being prescribed, while higher cost to the insurer does not. Hellstrom and Rudholm argue that the uncertainty about the quality of generic drugs incites physicians to prescribe brand-name drugs. Their empirical evidence shows that physicians are indeed less likely to allow generic substitution for older (and presumably sicker) patients. However, their measure of uncertainty about quality came out insignificant in the decision equation.

Another reason why the prescription of generic drugs might require extra effort on the part of the physician is given by Griliches and Cockburn (1994). They argue that many patients perceive generic drugs as less safe and of lower quality, making the patient suffer a 'putative loss' when using them. Therefore, a physician prescribing the generic drug needs to convince the patient of its bioequivalence.

To our knowledge, there is no Swiss study that analyzes the effect of PD on the choice between generic and brand-name drugs. The one exception is Hunkeler (2008) who presents corroborating evidence for the hypothesis that PD leads to margin optimization or even margin maximization[3] through dispensing packages and dosages with higher official physician margins. These packages are launched first by companies entering the generics market; later, they are complemented by additional package sizes

[3] The difference between margin optimization and maximization is that in the first case, PD providers prescribe several small packages instead of one large package while in the second case, they prescribe a higher quantity to maximize their income.

and dosages (for more institutional detail regarding Swiss health insurance, see Section 5.3). The other studies of PD in Switzerland have focused on its impact on total physician billings or health care expenditure (HCE), respectively. An early investigation by Zweifel (1985) concluded that while PD creates incentives to keep patients out of the hospital (where different physicians are in charge as a rule), the savings achieved through a reduced rate of hospitalization fall short of the extra drug expenditure induced in ambulatory care. At a more aggregate level, Dummermuth (1993) compares two otherwise similar neighboring cantons (Lucerne with PD and Argovia without PD), finding PD to be associated with slightly higher per capita drug expenditure as well as HCE. This finding is in line with Beck et al. (2004), who relate per-capita drug expenditure to several properties of cantons, among them, their PD status. By way of contrast, Vatter and Ruefli (2003), who control for a very comprehensive set of political and socioeconomic covariates, indentify a significantly negative effect of the share of PD providers on per capita HCE. More surprisingly still, Schleiniger et al. (2007) estimate a significantly negative effect of PD on cantonal drug expenditure which is robust across several specifications.

5.3 Institutional setting

Basic health insurance coverage in Switzerland written by some 80 competing private not-for-profit insurers is mandatory for a broad basket of services and drugs. Physicians in private practice are mostly paid according to a nationwide uniform fee schedule called TARMED [see Zweifel and Tai-Seale (2009) for description and criticism].[4] Provision of health care is decentralized and the 26 Swiss cantons ('jurisdictions') have considerable say in its regulation, including the regulation of drug dispensing.

[4] A small number of physicians works in managed-care type arrangements, where other modes of payment are possible.

5.3.1 Physicians' dispensing rights

Thirteen of the twenty-six Swiss cantons give dispensing rights to all physicians, seven apply mixed systems while six generally disallow PD. Physicians who dispense on average derive about 18 percent of their revenue from PD. This number is higher for general practitioners (28 percent) and lower for specialists (8 percent) [see Hunkeler (2008)]. Therefore, the financial incentives linked with the amount and structure of PD are substantial. Acknowledging problems of asymmetric information between physicians and patients, some cantons with PD require physicians to inform patients about their right to obtain a prescription to be filled by the pharmacy of their choice.

In the context of the present study, an important question is whether cantons that allow PD attract substantially different types of physicians than do non-PD cantons. Since the data is provided by a health insurer, they do not contain information about the determinants of locational choice such as regional origin of the physician and her spouse, or the location of her medical school. This makes an analysis of physicians' choice of location impossible. Moreover, it is known that young physicians mainly take over existing practices rather than opening new ones in response to large administrative hurdles, pointing to a narrowed choice of location. Still, if physicians who are very susceptible to financial incentives are disproportionately located in the PD cantons, our estimates in Section 5.7 might be upwardly biased.[5]

5.3.2 Contributions to income from drug dispensing

For non-PD practitioners, the contribution to income from dispensing is zero. For PD practitioners, the contribution earned by selling a specific drug consists of three components, namely (i) a fixed lump sum, (ii) a percentage of the regulated manufacturer price, and (iii) discounts that are conceded to physicians by pharmaceutical companies. The first two components are regulated by the government and published in official registers. The third component is the outcome of an individual bargaining process between

[5] This may be true although dummy variables for cantons and community types are included in the estimation in order to control for differences between regions (see Section 5.7).

prescriber and sales representative, which is unobservable to us. However, they ultimately reflect the bargaining position of the pharmaceutical company, about which a few facts are known.

According to Liu et al. (2009), the discount on manufacturers' prices offered increases with market size, competition, and retail price but decreases with marginal cost. First, market size is small in Switzerland for both brand-name and generic drugs. With regard to competition, the market usually contains one brand-name drug only but a large number of generic alternatives (more than 10 in this analysis). Therefore, producers of generic drugs are more likely to use discounts in their attempt to increase market share. Next, marginal cost of brand-name and generic drugs can be assumed equal in the present setting.

In addition, international comparisons of reimbursement prices offer indirect evidence suggesting that generic producers in Switzerland have ample leeway for discounts. For fixing the reimbursement price of brand-name drugs, Switzerland uses a reference group comprising Germany, Denmark, UK, the Netherlands, France, Italy, and Austria. Reimbursement prices for generic drugs have to be at least 40 percent lower than those of the original drug. However, this does not imply that generic producers earn lower effective margins. In fact, Santesuisse (2009) and IMS (2009) calculate price indexes for drugs with and without patent protection for Switzerland and the seven countries cited above. The two studies conclude that both prices for band-name (p_b) and generic drugs (p_g) are higher in Switzerland, i.e. $\Delta p_b = p_b - p_b^R > 0$ and $\Delta p_g = p_g - p_g^R > 0$, where R denotes the average drug price in the reference group. But they also find that the international price difference is larger in the case of generic than for brand-name drugs ($\Delta p_g > \Delta p_b$). Assuming that producers have the same cost structure in Switzerland and elsewhere, the extra profit margin earned in Switzerland is therefore higher for generic than for brand-name producers, i.e. $\tilde{m} = \Delta p_g - \Delta p_b > 0$. They can use their net advantage $\tilde{m}$ for inducing physicians to prescribe their products.

In all, manufacturers of generic drugs are likely to offer larger discounts to physicians than brand-name producers. Indeed, interviews conducted with Swiss wholesalers and physicians support the notion that prescribers derive more income from generic drugs, although no market participant is willing to publish the exact discounts that are offered or accepted.

In the context of the present study, it is important to note that the law forbids to give, promise or accept any monetary or monetary equivalent reward for the prescription of a specific drug. Therefore, manufacturers are not allowed to promise rewards (for example higher discounts) for the achievement of a higher sales volume.

5.3.3 Copayment arrangements

Prescription drugs are covered by compulsory health insurance, which kicks in when the annual deductible is exceeded. The minimum annual deductible amounts to CHF 300 (1 CHF $\approx$ 1.1 USD at 2011 exchange rates). Voluntary deductibles range from CHF 500 to 2,500 and are chosen by the insured at the beginning of the year. The deductible applies to all health care services except those related to maternity. When the deductible is exceeded, there is a 10 percent rate of coinsurance up to a stop-loss of CHF 700 per year. For instance, a patient with a deductible of CHF 2,500 would spend a maximum of CHF 3,200 out of pocket. For certain brand-name drugs, the rate of coinsurance was increased to 20 percent during our observation period (2005 to 2007). However, producers of brand-name drugs can escape this increased coinsurance by lowering their prices. As a consequence of different deductibles and changing rates of coinsurance, some patients have a stronger interest in receiving cheaper drugs than others.

5.4 Theoretical model of physicians' drug choice

Because of their central role in the resource allocation in health care markets, the behavior of physicians has spawned a very rich literature [see McGuire (2000) for an overview]. The purpose of this section is to derive testable hypotheses concerning generic drug substitution from existing theoretical models. Many of these models posit patients' health benefit as an argument in the physician's objective function. Thus, a physician (i) who prescribes a drug (d) to a patient (j) at time (t) has utility

$$V_{ijdt} = \alpha_i \Big[\pi_{idt} - e_{ijdt} \Big] + \beta_i \Big[b_{jd} - \theta_{jdt} p_{dt} u'\{Y_{jt}\} \Big] - \gamma_i \Big[(1-\theta_{jdt}) p_{dt} \Big] \quad (5.1)$$
$$\text{with } \pi_{idt} = f_{dt} + v_{dt} p_{dt} + \eta_{idt}.$$

Here, π_{idt} denotes the contribution to physician income. As explained in Section 5.3.2, it consists of a fixed lump sum (f_{dt}), a price-dependent component ($v_{dt}p_{dt}$), and an unobserved discount that is the outcome of an individual bargaining process between the physician and the pharmaceutical company (η_{idt}). For the reasons listed in Section 5.3.2, we assume that both discounts and total contributions to physician incomes are higher for generic than for brand-name drugs.

The effort (in money terms) associated with prescribing is denoted e_{ijdt}. In keeping with the literature cited in Section 5.2, this effort is higher for a generic ($d = g$) than a brand-name ($d = b$) drug. For simplicity, the cost of prescribing b is normalized to zero ($e_{ijbt} = 0$). The higher prescribing effort for generic drugs stems from two main sources. First, the physician needs to gather personal experience with the generic drug, which she has already collected for the brand-name drug during the period of patent protection. This cost decreases over time, hence the dependence on time index t. Still, every patient is different, making matching patients with drugs challenging even after an initial information effort. Second, the physician needs to convince the patient that the lower-priced generic drug is not of lower quality. Otherwise, the patient might suffer a 'putative loss' in the sense of Griliches and Cockburn (1994), which might jeopardize the physician's reputation. This cost also declines over time as patients become acquainted with the generic drug. The parameter $\alpha_i > 0$ in Equation (5.1) denotes the weight the physician attaches to the drug's contribution to income. It may well differ between GPs and specialists.

The second term of Equation (5.1) symbolizes net patient benefit. Therefore, a weight $\beta_i > 0$ (with no systematic difference between GPs and specialists assumed) reflects a consideration for the patient's *total utility* derived from health benefit and disposable income [Bradley and Lesu (2006), De Jaegher and Jegers (2000)] rather than merely for the patient's *health benefit* [Ellis and McGuire (1986)]. Net patient benefit equals health benefit b_{jd} minus the drug's out-of-pocket price $\theta_{jdt}p_{dt}$, with θ_{jdt} denoting the patient's rate of coinsurance (which can be drug-specific) and p_{dt}, the price of the drug. The patient's utility from consuming other goods is $u\{Y_{jt}\}$, which is increasing and concave in patient's income Y_{jt} as well as additively separable from health. Since copayment for a single drug $\theta_{jdt}p_{dt}$ is small in our context, multiplying it by $u'\{Y_{jt}\}$ yields a good approximation of its impact on patient utility. As low-income patients have a high marginal utility of income, they suffer a particularly high utility loss from a given drug cost $\theta_{jdt}p_{dt}$. In the remainder of this paper, there will be no difference in health benefits between the brand-name and the generic drugs ($b_{jb} = b_{jg}$) because bioequivalent drugs are compared (see Section 5.6 for details).

The third term of Equation (5.1) is motivated by agency on behalf of the insurers. Agency towards insurers can be motivated by fear of sanctions or tighter regulation in future.[6] Both types of threats concern GPs and specialists alike. Moreover, high and rapidly increasing health insurance premiums are one of the top concerns of the Swiss population. Therefore, promoting a cost-efficient practice style could create a warm-glow effect of doing what is good for society. Here, $(1-\theta_{jdt})p_{dt}$ symbolizes the cost of the drug treatment falling on the patient's insurer, with $\gamma_i > 0$ indicating the importance of this concern. In view of Equation (5.1), types of (im)perfect agency can be defined as in Table 5.1.

The generic drug is prescribed if $V_{ijgt} > V_{ijbt}$, hence

$$\begin{aligned} V_{ijgt} - V_{ijbt} &= \alpha_i \Big[\pi_{igt} - \pi_{ibt} - e_{ijgt} \Big] + \beta_i \Big[(\theta_{jbt}p_{bt} - \theta_{jgt}p_{gt}) u'\{Y_{jt}\} \Big] \\ &\quad + \gamma_i \Big[(1-\theta_{jbt})p_{bt} - (1-\theta_{jgt})p_{gt}) \Big] > 0. \end{aligned} \tag{5.2}$$

6 The Swiss health insurers' association (Santesuisse) scrutinizes physicians who exhibit inexplicably high cost of treatment compared to their peers and occasionally sues them.

Types of agency	**Parameter values**		
	Physician	Patient	Society
Perfect agency	$\alpha_i = 0,$	$\beta_i > 0,$	$\gamma_i > 0$
Imperfect agency on behalf of patients	$\alpha_i > 0,$	$\beta_i > 0,$	$\gamma_i \geq 0$
Imperfect agency on behalf of insurers	$\alpha_i > 0,$	$\beta_i \geq 0,$	$\gamma_i > 0$
Lack of agency	$\alpha_i > 0,$	$\beta_i = 0,$	$\gamma_i = 0$

Table 5.1: Types of (im)perfect agency

Physician agency can now be analyzed with the help of Equation (5.2). To begin with, non-dispensing physicians do not obtain income from drug prescription ($\pi_{igt} = \pi_{ibt} = 0$), while dispensing physicians are likely to receive a higher income contribution from generic than from brand-name drugs ($\pi_{igt} > \pi_{ibt} > 0$, see Section 5.3.2).[7] PD is therefore expected to increase the prescription of generic drugs.

Hypothesis 1: Given imperfect or lack of agency, dispensing physicians are more likely to prescribe a generic drug compared to non-dispensing ones due to its higher income contribution.

Recall that due to bioequivalence, drug choice affects patient utility exclusively through differences in coinsurance. According to Equation (5.2), both perfect and imperfect patient-related agency thus leads to the prediction that generic drugs are prescribed more often to patients with a high rate of coinsurance (high θ_{jdt}) or low income (high marginal utility of income, $u'\{Y_{jt}\}$), than to other patients.

Hypothesis 2: Given imperfect agency on behalf of patients, generic drugs are prescribed more often to patients with higher rate of coinsurance as long as the brand-name drug is more expensive than the generic, $p_{bt} > p_{gt}$.

Hypothesis 3: Given imperfect agency on behalf of patients, generic drugs are prescribed more to patients with lower incomes because of their higher marginal utility of income.

[7] In fact, non-dispensing physicians get a fee (TARMED) for prescribing a drug, which however does not differ between brand-name and generic drugs. This fee is therefore irrelevant to our analysis.

For the decision whether or not to prescribe a generic drug, only the sign of Equation (5.2) is relevant. If the first term of Equation (5.2) is zero (as for all non-dispensing physicians), the second term becomes relatively more important for the determination of its sign. Therefore, to the extent that agency motivates physicians to prescribe generic drugs, the effect of patient coinsurance should be more marked for non-PD providers.

Hypothesis 4: Given imperfect agency on behalf of patients, patients' rate of coinsurance is more influential if the physician does not dispense drugs on his or her own account.

Many models of physician agency neglect the third term of Equation (5.2). However, if the influence of copayment represented by $[(\theta_{jbt}p_{bt} - \theta_{jgt}p_{gt})u'\{Y_{jt}\}]$ is low and $(\pi_{igt} - \pi_{ibt})$ is zero, as applies to non-PD providers, all that remains is the (extra) effort of prescribing the generic e_{ijgt}. Therefore, non-PD providers who treat patients with low coinsurance or high incomes should have a very low propensity to prescribe generics due to their higher cost of effort. It takes agency towards the payers of health care [$\gamma_i > 0$ in Equation (5.2)] to make them prescribe a generic.

Hypothesis 5: Given agency on behalf of insurers, non-PD providers prescribe generic drugs to some degree.

In addition to the standard fee-for-service arrangement, Swiss insurers may also offer policies with managed care-type restrictions. Most of these arrangements are aimed at increasing the cost-consciousness of physicians, either by introducing provider cost sharing or by selectively contracting physicians based on indication of efficiency. In both cases, these arrangements are expected to align the interests of physicians with those of the insurers, resulting in an increased influence of the price difference $(p_{bt} - p_{gt})$ on physicians in managed care-settings.

Hypothesis 6: Physicians working in managed care-type settings prescribe more generic drugs because of their increased consideration of the cost of care.

A limitation of our model is that it focuses on physician utility only. This is justified to the extent that asymmetric information about treatment options makes patients delegate their decision-making authority to physicians. However, this delegation is unlikely to be complete in practice. If patients play a more active role, observed choices are the outcome of a bargaining process between them and physicians [Ellis and McGuire (1990)]. It is important to keep this limitation in mind when interpreting the empirical results in Section 5.7. For example, the patient's rate of coinsurance may impact drug choice not only because of physician agency (as our model suggests), but also because of the patients' own actions.

5.5 Econometric specification

We estimate the choice between brand-name and generic drugs using a binary choice model. The dependent variable takes on the value one if the physician prescribes g and zero otherwise. Following Ben-Akiva and Lerman (1985), the physician's utility is split into a deterministic and a random component, i.e. $U_{ijdt} = V_{ijdt} + \varepsilon_{ijdt}$, where ε_{ijdt} is unobserved by the researcher. A physician prescribes drug g instead of b if and only if $U_{ijgt} > U_{ijbt}$. Hence, the probability of physician i prescribing g to patient j at time t is given by

$$P_{ijgt} = Pr(V_{ijgt} + \varepsilon_{ijgt} > V_{ijbt} + \varepsilon_{ijbt}) = Pr(V_{ijgt} - V_{ijbt} > \varepsilon_{ijbt} - \varepsilon_{ijgt}) \tag{5.3}$$

with $V_{ijgt} - V_{ijbt}$ given by Equation (5.2). If we assume the random term $\varepsilon_{ijt} \equiv \varepsilon_{ijbt} - \varepsilon_{ijgt}$ to have a logistic distribution, we get the logit choice probability

$$P_{ijgt} = \left(1 + e^{-(V_{ijgt} - V_{ijbt})}\right)^{-1} \tag{5.4}$$

which permits to derive and interpret odds ratios. The drawback of the logit model compared to the probit is that no simple estimators are available as soon as a physician-specific random effect is included. In the probit model, the linear combination of the normal error term and the normal random effect results in a normal distribution. This is not the case for the logit model [see Wooldridge (2002), Chapter 15]. By including a physician-specific error term, we allow for within correlation among the observations belonging to the same physician while still assuming independence of observations across physicians. The physician-specific error captures unobserved factors that we are not able to control for [see also Lundin (2000)]. Examples of unobserved factors that may affect drug choice are favorable experience with a specific drug or the impact of pharmaceutical sales representatives visiting the physician. Therefore, we extend the random utility model above to allow for a physician-specific random effect, i.e. $U_{ijdt} = V_{ijdt} + \nu_i + \varepsilon_{ijdt}$. If $\nu \sim N(0, \sigma_\nu^2)$ one obtains the one-level random-effects logit model [see Wooldridge (2002), Chapter 15], with the share of total variance contributed by physician-level variance given by $\rho = \sigma_\nu^2/(\sigma_\nu^2 + \sigma_\varepsilon^2)$ where σ_ε^2 denotes the variance of the overall error term. In addition, one could allow for patient-specific random effects by nesting them with physician-level ones, resulting in a two-level hierarchical regression model (also called mixed-effects model, see Rabe-Hesketh et al. (2001)). While theoretically attractive, the mixed-effects model could not be estimated due to the complexity of the estimation equation and the size of the dataset.[8] Therefore, we estimated the one-level random-effects model discussed previously. Testing the importance of the physician-specific error term using a likelihood ratio test showed that the one-level random-effects model performed better than the pooled logit regression.

To estimate the coefficients of interest, the systematic component of the utility function $(V_{ijgt} - V_{ijbt})$ needs to be specified. Unfortunately, it is not possible to unambiguously relate the variables of the theoretical model to observed quantities. Still, it is possible to test all the hypotheses that were stated in Section 5.4. The assignments are displayed in Table 5.2.

As explained in Section 5.3.2, we cannot observe the *true* income contribution from physician dispensing, but we expect it to be higher for generic than for brand-name drugs [$\pi_{igt} - \pi_{ibt} > 0$ in Equation (5.2)]. Therefore, we can only include a dummy that

8 The mixed-effects model did not converge using Stata 10.

Variable	**Term No. Eq. (2)**	**Hyp. No.**	**Exp. sign**	**Con-firmed?**[a)]
Physician dispensing (PD)	1	1	+	Y (O,A)
General Practitioner (GP)	1	n.a.	+	Y
Interaction of PD and GP	1	1	+	Y
Deductible category (DED2, DED3)	2	2	+	Y (O,A)
Interaction of PD and DED2, DED3	2	4	-	N
Increased rate of coinsurance (COINS)	2	2	+	Y
Interaction of PD and COINS	2	4	-	N
Extra hospital insurance (HOSP)	2	3	-	Y
Accident coverage (ACC)	2	3	-	Y (O,A)
High income area (HIA)	2	3	-	Y (O,A)
Price difference (P)	3	5	+	N (Y for O)
Interaction of PD and P	2,3	n.a.	-	N (Y for O)
HMO contract (HMO)	3	6	+	Y
Gatekeeping contract (GATE)	3	6	+	Y

Control variables: six area types, 25 cantonal dummies, complementary insurance, time trend, patient age and sex, dosage, prescriptions per patient, year of first prescription.

Note: [a)] see Section 5.7.

Table 5.2: Overview of the variables used for hypothesis testing

indicates whether or not a physician earns an income contribution from dispensing ($PD_{it} = 1$). We expect the coefficient pertaining to the income contribution to be positive, implying that PD increases the probability of choosing g.

The information cost (e_{ijgt}) in Equation (5.2) cannot be measured and thus is absorbed by the random term. A dummy for general practitioners (GP) is interacted with PD to test for systematic differences in α_i of Equation (5.2), i.e. whether GPs react in a different way to the financial incentives from PD than specialists do. A positive interaction effect is expected due to the lower average income of GPs and hence higher marginal utility of income.

Copayment borne by patients is known from the patient's health insurance policy on the one hand and the drug-specific rate of coinsurance on the other. As explained in Section 5.3.3, policies differ in terms of deductibles (DED). Physicians acting as agents [$\beta_i > 0$ in Equation (2)] would want to keep patients' out-of-pocket cost low. The higher

DED, the more they are expected to prescribe the cheaper generic (Hypothesis 2). In formulating this hypothesis, DED is viewed as exogenous. Admittedly, high deductibles are typically chosen by higher-income individuals, making θ_{jdt} a function of $u\{Y_{jt}\}$ in Equation (2). However, the dataset lacks information that would permit to control for this relationship. Hypothesis (2) can be detailed further. Before January 2006, drug expenditure in excess of DED was subject to a 10 percent coinsurance rate regardless of type g or b. A natural experiment is provided by the policy change of 2006, when the coinsurance rate for (some) brand-name drugs was increased from 10 to 20 percent while it stayed at 10 percent for generics. Producers of brand-name drugs can escape the increased rate of coinsurance by lowering their prices, which is observed in our dataset (see Section 5.6). The effect of the patient's rate of coinsurance on drug choice can be tested by including a dummy COINS that is one if the prescribed drug faces the increased rate of coinsurance at the time of purchase and zero otherwise. In addition, an interaction term PD·COINS serves to test for the influence of financial incentives on physician agency. According to Hypothesis 4, its coefficient is predicted to be negative, indicating less additional generic substitution in the case of physician dispensing.

The hypothesis that generic drugs are prescribed less to patients with higher income due to their lower marginal utility of income (Hypothesis 3) is tested by including dummies for residence in a high-income area (HIA), the purchase of extra hospital insurance (HOSP), and the purchase of accident insurance (ACC). Accident coverage is inversely related to labor force participation because it is usually provided by the employer rather than the health insurer. It thus may be interpreted as an indicator of high income, causing less prescription of generics according to Hypothesis 3.

As to the third term of Equation (5.2), Hypothesis 5 (bearing on γ_i, the role of agency on behalf of insurers) can be tested using the price difference between the brand-name and generic drug ($p_t = p_{bt} - p_{gt}$), to be detailed below. Concerning the relevance of this agency, the following argument can be made. Beyond the deductible, the price difference borne by patients is very small compared to average income. Thus, it is unlikely that consideration for the patients' coinsurance [second term in Equation

(5.2)] provides enough motivation for most of non-dispensing physicians to bear the greater cost of prescribing generic drugs (e_{ijgt}). Therefore, the fact that the market share of generic drugs in our dataset is substantial in the non-PD setting (see Table 5.3) supports the view that $\gamma_i > 0$ in Equation (5.2), suggesting that physicians do consider the cost to insurers when choosing a drug. The interaction term PD·P is used to test whether physician agency is weakened by physician dispensing. As the price difference is part of both the second and the third term of Equation (5.2), both agency on behalf of insurers or agency on behalf of patients could be affected here.

For calculating the price difference, note that it has to be calculated for each combination of package size and dosage, with p_{gt} denoting the average price of N generic products each time. Further, since prices are subject to change, the price difference for a specific size-dosage combination has to be calculated for each month t, i.e. $p_t = p_{bt} - (\sum_n p_{nt})/N \ \forall n = g$. For some of these combinations, only one version is available and no price difference can be calculated. These observations are excluded from the regression analysis. This is not a problem because a prescriber who needs this specific amount of pills and dose does not have a choice between b and g.

For testing Hypothesis 6, differences in health insurance policies can be exploited. Apart from conventional fee-for-service contracts with varying deductibles, consumers can opt for a Health Maintenance Organization (HMO) or a gatekeeping alternative (GATE). In the HMO setting, physicians are paid by capitation rather than the usual fee-for-service. The gatekeeping arrangement uses fee-for-service payments but requires patients to obtain a referral from their general practitioner (chosen from a list issued by their insurer) before seeing a specialist. Moreover, patients in a gatekeeping plan are required to ask for generic drugs. Hypothesis 6 states that both kinds of arrangements should lead to increased consideration of the cost of care by prescribing physicians [higher γ_i in Equation (5.2)] and hence more generic drugs being prescribed. However, it is important to note that patients choosing these contracts are likely less risk-averse and more price sensitive than patients opting for the standard fee-for-service setting.

These differences relate to the second rather than third term of Equation (2) yet also contribute to more generic drugs being prescribed.

We complete the econometric specification by a few control variables. Because we expect a positive time trend in favor of generic drugs as practitioners get more familiar with them, we include a variable for the time trend. Patient age and gender serve to control for demographic effects. Also, political attitudes and institutions vary between cantons. In some, PD is widely accepted or even desired while in others, it is disputed. Moreover, unobserved detailing effort by pharmaceutical companies likely differs between cantons. This calls for the inclusion of 25 cantonal dummies, with Zurich constituting the reference category. Individuals can also purchase complementary insurance that covers additional procedures (such as traditional Chinese medicine or otherwise uncovered drugs). These dimensions of complementary insurance likely reflect risk aversion on the part of consumers, making them eschew drug substitution because they are less familiar with the generic alternative.

Drug substitution may also depend on dosage and package size. The reason is that the unobserved contribution to physician income could vary with these two parameters. Therefore, total prescribed dose (number of pills times dosage per pill) is included in the regression. The number of prescriptions per patient controls for long-run chronic patients. Because there is a high likelihood that a patient initiated with a given variety of the drug remains with it, two dummies indicate whether the patient's first prescription took place in 2006 or 2007, when the higher coinsurance rate was already in place.

The deterministic part of utility for generics is estimated as

$$\begin{aligned} V_{ijgt} = \; & b_0 + b_1\mathrm{PD} + b_2\mathrm{GP} + b_3\mathrm{PD}\cdot\mathrm{GP} + b_4\mathrm{DED2} + b_5\mathrm{PD}\cdot\mathrm{DED2} + b_6\mathrm{DED3} \\ & + b_7\mathrm{PD}\cdot\mathrm{DED3} + b_8\mathrm{COINS} + b_9\mathrm{PD}\cdot\mathrm{COINS} + b_{10}\mathrm{HOSP} + b_{11}\mathrm{ACC} \\ & + b_{12}\mathrm{HIA} + b_{13}\mathrm{P} + b_{14}\mathrm{PD}\cdot\mathrm{P} + b_{15}\mathrm{HMO} + b_{16}\mathrm{GATE} + b_x X, \end{aligned} \tag{5.5}$$

where the b's are the parameters of interest, X denotes the vector of control variables, and b_x the vector of coefficients of the control variables.

5.6 Data

5.6.1 Chemical agents selected

The data was provided by a major Swiss health insurer covering about 15 percent of the Swiss population. They relate to the years 2005 to 2007. The chemical agents selected for analysis are omeprazole (O), amlodipine (A), and ciprofloxacin (C).[9] Omeprazole is used to treat gastric and duodenal abscesses; amlodipine is a calcium channel blocker for the treatment of angina; ciprofloxacin is used to treat specific bacterial infections. Their choice can be justified on the grounds that they have many bioequivalent generic competitors that are available on the Swiss market.[10] Furthermore, these agents belong to the therapeutic categories with substantial sales volume, causing the number of prescriptions in the data to be high. We observe 183,874 (O), 143,358 (A), and 95,580 (C) prescriptions where exactly one package was sold.

The shares of the three brand-name drugs in the sample are depicted in Figure 5.1 for 33 months, starting from March 2005. They dropped throughout 2005, quite likely because prescribing physicians anticipated the increase of coinsurance for certain brand-name drugs from 10 to 20 percent effective January 2006. The new rate was to apply to brand-name drugs whose sales price was 20 percent higher than the cheapest therapeutically equivalent generic.[11] During the first months of 2006, this was the case for all three agents. However, the brand-name producers of amlodipine and ciprofloxacin lowered their prices in month 20 (August, 2006) in order to avoid the extra copayment. In month 29 (May, 2007), the producer of the brand-name for omeprazole lowered its prices as well, but only for the most commonly prescribed dose (10 mg).

[9] ATC-code: omeprazole (A02BC01), amlodipine (C08CA01), ciprofloxacin (J01MA02). For more details about the investigated agents see *www.drugbank.ca/drugs*.

[10] Number of generics available on the Swiss market (2005–2007): omeprazole (11), amlodipine (12), ciprofloxacin (11).

[11] This is regulated by national law (specifically paragraph Art.38a KLV).

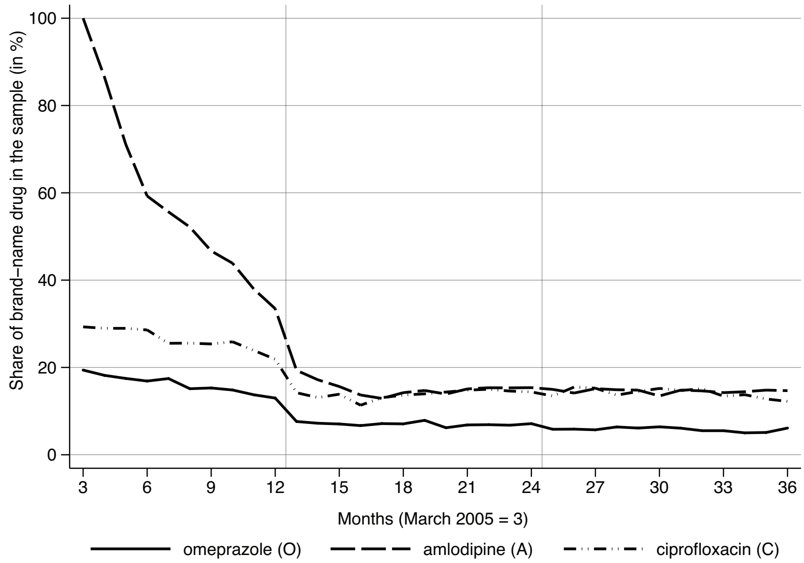

Figure 5.1: Share of brand-name drug between March, 2005 and December, 2007

As to amlodipine, the brand-name drug (Norvasc®) went off patent in the spring of 2005, causing it to lose its monopoly position. Since then, the generic Amlodipin-Mepha® has expanded its share in the sample from 18 to 37 percent (2006) and to 38 percent (2007), respectively.

	Omeprazole		**Amlodipine**		**Ciprofloxacin**	
Physician dispensed?	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Sample share of generics	94%	89%	82%	66%	86%	79%
Sales of generics $^{a)}$	6.3	9.2	3.7	3.5	2.0	1.7
Sales of brand-names $^{a)}$	1.0	2.8	1.5	3.1	0.4	0.6

Note: $^{a)}$ Values are shown in CHF, mn. for the period between March 2005 and December 2007. 1 CHF ≈ 1.1 USD at 2011 exchange rates.

Table 5.3: Sample shares and sales volumes of generic and brand-name drugs

5.6.2 Physician and patient descriptors

In the data set, there are 7,441 physicians prescribing O, 5,995 prescribing A, and 7,693 prescribing C, respectively (the three subsets are overlapping); the share of PD varies between 43 and 54 percent from March 2005 to December 2007. With 78 to 88 percent, the majority of the prescribers are GPs rather than specialists.

The median deductible is the lowest possible (CHF 300). During the study period, about 70 percent of omeprazol prescriptions were subject to the increased rate of coinsurance while this share was lower for amlodipine and ciprofloxacin with shares of 21 and 20 percent, respectively. The share of consumers with extra hospital coverage lies between 22 and 27 percent. The majority of physicians have their practice in urban (36-40 percent) or suburban (25-27 percent) areas while only 3 percent are located in high-income areas. The average savings per prescription for a patient or insurer due to the substitution of the brand-name by a generic counterpart is highest for O with CHF 102, followed by CHF 28 and CHF 12 for A and C, respectively. The share of insured with an HMO policy varies between 2 and 3 percent, of those with a gatekeeping policy, between 5 and 6 percent. In contrast, between 87 and 90 percent of the insured had signed up for at least one voluntary extra option to broaden the scope of reimbursed services. High shares of 68 and 83 percent have purchased accident insurance. Both the 61,825 patients receiving O and the 27,080 patients receiving C have an average age of about 60 years, and 40 percent are male. The 58,489 patients obtaining A have an average age of 70 years, and 48 percent are male. Ciprofloxacin is prescribed with an average total dosage per prescription of 6,126 mg, compared to a dosage of 999 mg for O and 620 mg for A. On average, a patient receives 8 prescriptions if in need of O or A. In contrast, C is prescribed three times per patient on average. Observations are distributed equally over the three years, with about one third of prescriptions taking place per year. Also, the number of patients starting medication is roughly constant over the years.

	Omeprazole			**Amlodipine**			**Ciprofloxacin**		
	MN	**MD**	**SD**	**MN**	**MD**	**SD**	**MN**	**MD**	**SD**
Physician dispensing (PD)	0.43	0.00	0.50	0.47	0.00	0.50	0.54	1.00	0.50
General practitioner (GP)	0.84	1.00	0.37	0.88	1.00	0.32	0.78	1.00	0.42
Patient's deductible (DED)	406	300	297	386	300	246	477	300	413
Increased rate of coinsurance (COINS)	0.72	1.00	0.45	0.21	0.00	0.41	0.20	0.00	0.40
Extra hospital insurance (HOSP)	0.22	0.00	0.42	0.27	0.00	0.44	0.25	0.00	0.43
Accident insurance (ACC)	0.75	1.00	0.43	0.83	1.00	0.37	0.68	1.00	0.47
High-income area (HIA)	0.03	0.00	0.16	0.03	0.00	0.16	0.03	0.00	0.17
Urban area	0.38	0.00	0.49	0.36	0.00	0.48	0.40	0.00	0.49
Suburban area	0.26	0.00	0.44	0.27	0.00	0.44	0.25	0.00	0.43
Average price difference (P)	102	71	75	28	11	30	12	8	9
HMO contract (HMO)	0.03	0.00	0.16	0.02	0.00	0.13	0.02	0.00	0.14
Gatekeeping contract (GATE)	0.05	0.00	0.22	0.05	0.00	0.22	0.06	0.00	0.24
Complementary insured (COMP)	0.87	1.00	0.33	0.89	1.00	0.32	0.90	1.00	0.31
Patient's age (in years)	62	64	17	70	72	12	58	61	19
Patient's sex (male=1)	0.38	0.00	0.49	0.48	0.00	0.50	0.40	0.00	0.49
Total dosage (in 100 mg)	9.99	11.20	5.90	6.20	5.00	2.80	61.26	50.00	28.60
Prescriptions per patient	7.84	6.00	7.55	8.05	8.00	4.02	2.83	2.00	3.78
First prescription in 2006	0.35	0.00	0.48	0.36	0.00	0.48	0.36	0.00	0.48
First prescription in 2007	0.39	0.00	0.49	0.38	0.00	0.48	0.36	0.00	0.48
Share of prescriptions in 2006	0.35	0.00	0.48	0.36	0.00	0.48	0.36	0.00	0.48
Share of prescriptions in 2007	0.38	0.00	0.49	0.38	0.00	0.49	0.36	0.00	0.48

Note: Descriptive statistics are mean (MN), median (MD), and standard deviation (SD). The prescription is the unit of observation used for calculating the statistics.

Table 5.4: Descriptive statistics

5.7 Estimation results

The odds ratios (ORs) and standard errors resulting from the random-effects logit model described in Section 5.5 are displayed in Tables 5.5 and 5.6.[12] The physician-specific variance component contributes 50 to 70 percent of the total error variance, and a likelihood-ratio test clearly speaks in favor of the random-effects specification. The physician-specific variance component is higher than the 40 percent reported by Lundin (2000) and 29 percent reported by Hellerstein (1998). A possible explanation is that some physicians in our dataset only have a small number of patients, the data coming from one insurer only. Moreover, the available information does not permit to distinguish between part-time and full-time, female and male, and younger and older physicians. Coscelli (1998) also mentions considerable physician-specific components in unexplained variance.

5.7.1 Testing for the influence of physician dispensing

Hypothesis 1 predicts that physician dispensing (PD) increases the likelihood of generic prescription. It is tested by Model 1, with physician and patient characteristics controlled for. Additional hypothesis testing calls for interaction terms involving PD and patient characteristics which are added in Model 2 (to be discussed in Section 5.7.2). Therefore, the coefficient of PD in Model 1 shows the average OR across physician and patient groups. In the case of O, it amounts to 3.0 (2.6, 3.4), with the parentheses indicating its 95% confidence interval.[13] For a detailed discussion of its calculation, see Norton et al. (2004) and Garrett (1997). The OR indicates that if the drug is sold on the physician's own account, the odds of generic substitution are three times higher no matter whether the prescriber is a GP or a specialist. For all three agents, the likelihood of generic substitution is around twice as high among GPs than among specialists.

[12] The concept of odds ratios and their calculation in the presence of interaction terms can be found in Hosmer and Lemeshow (2000).

[13] The 95% confidence interval is calculated according to $CI = exp(\hat{\beta} \pm 1.96 \cdot \widehat{SE}(\hat{\beta}))$, where $\hat{\beta}$ is the logit coefficient. Because Tables 5.5 and 5.6 show ORs, the reader can calculate the necessary quantities according to $\hat{\beta} = ln(\widehat{OR})$ and $\widehat{SE}(\hat{\beta}) = \widehat{SE}(\widehat{OR})/\widehat{OR}$ using the values from the table.

Moreover, the interaction between PD and GP yields a positive and significant coefficient in the case of A and C. This could be a sign that GPs with their lower average income, hence higher marginal utility of income, are more influenced by the income contribution of PD than their specialized colleagues. In the case of O, the interaction of PD and GP was insignificant and therefore excluded from the estimation.

The effect of (PD·GP) cannot be inferred from the interaction coefficient directly but needs to be calculated according to the different categories has to calculated [see Norton et al. (2004)]. In present case, it is given by $exp(\hat{\beta}_{PD})$ for specialists and $exp(\hat{\beta}_{PD} + \hat{\beta}_{PD \cdot GP})$ for GPs. For amlodipine, PD has an OR of 2.4 (1.9, 2.9) for specialists and 3.7 (3.4, 4.1) for GPs, indicating that physician dispensing has a much stronger effect among GPs than among specialists. In the case of C, the discrepancy between GPs and specialists is even stronger. Dispensing specialists reveal a negative PD effect with an OR of 0.7 (0.6, 0.8), while GPs again exhibit a positive PD effect on generic substitution with an OR of 2.9 (2.6, 3.3). All the OR values discussed have confidence intervals that do not include 1 and thus are significant.

In summary, Hypothesis 1 receives a good deal of support, permitting one to conclude that physician dispensing increases the likelihood of generic substitution due to its higher contribution to physician income. This conclusion holds regardless of whether prescribers are GPs or not and for all of the three chemical substances analyzed, with the one exception of specialized physicians prescribing C. However, it should be noted that there may be additional reasons for dispensing physicians to choose the cheaper generic drug. First, storage entails capital user cost, which is lower for cheap generics. Second, dispensing physicians may be better informed about availability and prices of generics than non-dispensing physicians because of especially targeted marketing activities. Unfortunately, these effects cannot be analyzed with the available data. Still, PD is associated with increased generic substitution. It contributes to lower pharmaceutical expenditure as long as it does not go along with an increase in drug use through supplier-induced demand. This qualification is not addressed here but is analyzed in other recent work. In particular, Rischatsch (2011) analyzes whether dispensing

	Omeprazole (O)		**Amlodipine (A)**		**Ciprofloxacin (C)**	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Physician dispensing (PD)	2.99***	3.34***	2.36***	2.24***	0.71***	0.74***
	(0.18)	(0.26)	(0.25)	(0.24)	(0.06)	(0.07)
General practitioner (GP)	2.12***	2.13***	1.91***	1.92***	2.21***	2.21***
	(0.22)	(0.22)	(0.16)	(0.16)	(0.19)	(0.19)
Interaction of PD and GP			1.58***	1.56***	4.09***	4.08***
			(0.18)	(0.17)	(0.42)	(0.42)
Deductible category DED2 [a)]	2.01***	2.22***	1.15**	1.06	1.02	1.07
	(0.17)	(0.23)	(0.07)	(0.08)	(0.05)	(0.07)
Interaction of PD and DED2		0.70*		1.26*		0.90
		(0.13)		(0.17)		(0.08)
Deductible category DED3 [a)]	1.95***	2.50***	1.25	1.42**	1.12	1.20
	(0.39)	(0.66)	(0.18)	(0.25)	(0.11)	(0.16)
Interaction of PD and DED3		0.51		0.71		0.85
		(0.21)		(0.20)		(0.17)
Increased coinsurance (COINS)	2.04***	1.89***	4.52***	4.58***	2.14***	2.26***
	(0.08)	(0.08)	(0.10)	(0.13)	(0.09)	(0.11)
Interaction of PD and COINS		1.35***		0.97		0.88*
		(0.07)		(0.05)		(0.06)
Extra hospital insurance (HOSP)	0.68***	0.68***	0.75***	0.75***	0.93**	0.93**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Accident insurance (ACC)	0.80***	0.80***	0.89***	0.89***	0.97	0.97
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
High-income area (HIA) [b)]	0.47***	0.48***	0.57***	0.57***	0.91	0.91
	(0.11)	(0.11)	(0.09)	(0.09)	(0.17)	(0.17)
Continued on next page...						

Table 5.5: Estimated odd-ratios from logistic regression (generics=1), part 1

	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Price difference (P, in 10 CHF)	1.03***	1.04***	0.82***	0.81***	0.94**	0.93**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)	(0.03)
Interaction of PD and P		0.97***		1.02***		1.00
		(0.00)		(0.01)		(0.03)
HMO contract (HMO) [c)]	1.94***	1.91***	1.99***	1.99***	1.37***	1.37***
	(0.25)	(0.25)	(0.25)	(0.25)	(0.15)	(0.15)
Gatekeeping contract (GATE) [c)]	2.43***	2.37***	1.63***	1.64***	1.35***	1.35***
	(0.21)	(0.21)	(0.09)	(0.09)	(0.09)	(0.09)
Complementary insurance (COMP)	1.15***	1.15***	1.17***	1.17***	1.00	1.00
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Time trend (in months)	1.03***	1.03***	1.08***	1.08***	1.05***	1.05***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Patient age (in 5 years)	1.01**	1.01**	0.98***	0.98***	0.99***	0.99***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Patient sex (male=1)	1.26***	1.26***	1.14***	1.14***	1.02	1.02
	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)
Tot. dosage (in 100 mg)	0.93***	0.93***	1.09***	1.09***	1.00*	1.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Prescription per patient	0.94***	0.94***	0.96***	0.96***	0.98***	0.98***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
First prescription in 2006	1.33***	1.32***	1.21***	1.21***	1.23***	1.23***
	(0.04)	(0.04)	(0.03)	(0.03)	(0.05)	(0.05)
First prescription in 2007	1.38***	1.37***	1.04*	1.04*	1.09*	1.09*
	(0.04)	(0.04)	(0.03)	(0.03)	(0.05)	(0.05)
Log-likelihood at convergence:	-35,970	-35,918	-51,481	-51,473	-29,390	-29,388
Observations/Physicians:	183,874/7,441		143,358/5,995		95,580/7,693	

Note: Standard errors displayed in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.10; Six additional area and 25 cantonal dummies are included but not shown here. [a)] DED2 = CHF 1,000 or 1,500, DED3 = CHF 2,000 or 2,500. Ref. categories are: [b)] urban area, [c)] basic insurance.

Table 5.6: Estimated odd-ratios from logistic regression (generics=1), part 2

physicians optimize their income contribution from drug dispensing by selling smaller packages, while Trottmann (2011) looks at the impact of physician dispensing on total expenditure for drugs, general practitioners' services, specialists' services and hospital services.

5.7.2 The role of physician agency on behalf of patients

To the extent that physicians take the consequences of their prescriptions for the utility of their patients into account, Hypothesis 2 predicts a positive relationship between copayment and generic substitution. Patients with a higher deductible face a higher expected level of copayment; therefore, they should be more likely to receive the generic alternative. The empirical evidence comes from the coefficients of DED2 and DED3 in Model 2 of Table 5.5. In the case of O, the ORs for DED2 and DED3 indicate that a higher deductible increases the likelihood of generic substitution. Patients with a deductible in excess of the legal minimum are two times as likely to receive a generic drug, which supports Hypothesis 2. A stronger effect for DED3 compared to DED2 could not be found for O, however. For A, the ORs increase from the lowest to the highest deductible category, but only the OR for DED2 is statistically significant. The tendency is the same for C but the effect is insignificant. The dummy variable indicating the 2006 increase in coinsurance for expensive brand-names (COINS) is strongly positive for all chemical agents, again supporting Hypothesis 2 (see Table 5.2).

Hypothesis 3 revolves around patient income, stating that richer patients are less likely to receive the generic drug. In Table 5.5, three indicators are used, viz. the purchase of extra hospital insurance, accident insurance, and residence in a high-income area. As to the first indicator, the OR values are consistently below one, indicating that generic drug substitution indeed is less likely. The same is also true for patients with accident insurance and from high-income areas in two of the three cases (C is the exception with a negative but insignificant effect). Therefore, there is some supporting evidence for Hypothesis 3 (see Table 5.2 again).

Hypothesis 4 predicts that patients' rate of coinsurance is less influential in the PD mode than in the pharmacy mode. To test it, Model 2 contains interactions between the DED dummies and PD. The interaction terms are generally negative, but only the medium category for O is significant, giving some support to Hypothesis 4. Here, the OR for DED2 is 2.2 (1.8, 2.7) for non-PD and 1.6 (1.1, 2.1) for PD. Evidence contradicting Hypothesis 4 comes from A, where the interaction effect PD·DED2 is positive and significant but the main effect DED2 is insignificant, leading to the conclusion that non-PD providers do not react to a higher deductible but PD providers do. This difference vanishes again at the highest deductible level since PD·DED3 does not reach statistical significance.

A second test of Hypothesis 4 is provided by the interaction of PD with COINS. However, the evidence is inconclusive. For omeprazole, PD·COINS is highly significant and positive with an OR of 1.9 (1.7, 2.0) among non-PD providers and 2.6 (2.3, 2.8) PD providers, respectively, while for ciprofloxacin, it is weakly significant but negative, suggesting that PD providers react less to the increase in the rate of coinsurance than their non-PD colleagues. No significant difference could be found for amlodipine. Hence, the evidence does not permit to either confirm or reject the notion that drug dispensing weakens physician agency on behalf of the patient.

5.7.3 The role of physician agency on behalf of insurers

Hypothesis 5 states that given agency on behalf of insurers, non-PD providers prescribe generic drugs in spite of higher information cost. Therefore, we expect a higher difference between brand-name and generic prices ($p_{bt} - p_{gt}$) to be positively related to the probability of prescribing the cheaper generic drug. While the estimates for O support Hypothesis 5 with a weak positive effect in favor of generics, the estimates for A and C do not because an increase in the price difference lowers the probability of generic substitution slightly. However, there is other evidence hinting at agency on behalf of insurers. In fact, the descriptive statistics in Table 5.3 show that, for the three selected agents, the share of generic drugs is 66-89 percent in our dataset even in the non-

PD market. Recall that non-PD providers do not benefit financially from drug choice, while patient coinsurance beyond the deductible is rather limited compared to average income in Switzerland. Therefore, the high share of generic drugs shows that some physicians choose the lower-priced alternative even in situations when neither they nor their patients derive significant financial benefit from it. It takes agency toward the insurers to motivate physicians to prescribe generic drugs despite higher information cost.

The interaction PD·P is again used to test whether the financial incentives attached to PD weaken physician agency. The price difference being part of both the second and the third term of Equation (5.2), both agency on behalf of the patient and on the behalf of the insurer can be affected. For O, the price difference has an OR of 1.0 (1.03, 1.05) for non-PD physicians and an OR of 1.01 (1.00, 1.02) for PD physicians, pointing to a weakly negative association of PD and agency. The opposite is observed in the case of A, where the OR pertaining to non-PD providers is 0.81 (0.80, 0.82) and the OR pertaining to PD providers is 0.83 (0.82, 0.83). For C, no significant difference between non-PD and PD providers is observed, with ORs amounting to 0.93 (0.88, 0.99) and 0.94 (0.88, 1.00), respectively. Therefore, the evidence with regard to the interaction of PD and agency is inconclusive.

With respect to Hypothesis 6, the managed-care variables 'HMO' and 'gatekeeping' reveal an increasing likelihood of generic substitution for all three chemical agents, with ORs between 1.4 and 2.0, as predicted (see Table 5.2).

5.7.4 Control variables

The control variables lead to the following conclusions. In Model 2 of Table 5.6, there is evidence for the expected positive time trend towards generic drugs, a higher likelihood of generics being prescribed to men compared to women, no evidence of the total amount of dosage prescribed having influence on the choice of drug version, and a negative effect of number of prescriptions on the likelihood of generic prescription. Finally, the year when the patient's medication started is important for drug choice and significant for all three chemical agents. Patients who received the first prescription in 2006 are between 1.2 and 1.3 times more likely to be prescribed a generic. In the case of amlodipine and ciprofloxacin, the likelihood for 2007 is higher than for 2005 but lower than for 2006. This could reflect the fact that the two pertinent brand-name producers lowered their price in the interest of a decreased coinsurance rate, enabling them to regain market-share. By way of contrast, the brand-name producer of omeprazole waited until 2007, causing it to lose market share in both years.

One might criticize that dispensing physicians do not react to an individual patient when choosing between g and b because they have already decided what pharmaceuticals to have in their portfolio. However, they are likely to make this choice anticipating the kind of patients they will face from past visits, causing them to store the drugs that best match their clientele.

5.8 Conclusions

This research analyzes the role of physicians' and patients' financial incentives in the choice between generic and brand-name drugs. Prescribing the generic alternative takes more effort on the part of the physician for two main reasons: First, she needs to acquire information about new drugs which enter the market only after patent expiration of the brand name. Second, she needs to convince the patient that the cheaper generic is not of lower quality. The physician is willing to make this effort only if the benefit from choosing the generic is sufficiently high. Generic drugs have higher benefit because of three reasons, namely financial benefits, agency towards the patient, and agency towards insurers. The influence of these three components is estimated using a large set of drug claims data from Switzerland.

Regarding financial incentives, this data is ideal for analysis because some – but not all – Swiss physicians have the right to dispense drugs on their own account. Physicians with this privilege derive a significant part of their income from the sale of drugs, causing financial incentives associated with drug dispensing to be substantial. Physician dispensing is found to be associated with a higher likelihood of prescribing generic drugs, which is likely due to a higher contribution to physician income in comparison with that of brand-name drugs (Hypothesis 1; see also Table 5.2). A limitation of our analysis is that we are unable to separate this effect from other differences between dispensing and non-dispensing physicians. In particular, information costs for prescribing generic drugs might be lower for dispensing physicians as they are targeted by sales representatives and may therefore be better informed about availability and prices of drugs than their non-dispensing colleagues. Additionally, dispensing physicians have to finance and manage storage, tying up capital and causing opportunity costs.

Turning to agency towards patients, we test whether physicians respond to the financial burden caused by copayment. Choosing the lower-priced generic drug serves to decrease this burden without affecting the quality of medication due to bioequivalence of the generic substitutes studied here. We find that the likelihood of receiving the generic increases for patients with a higher deductible (Hypothesis 2). In addition, the rate of coinsurance (which applies when the deductible is exceeded) was increased for certain brand-name drugs during our observation period. Although this change caused but a small additional burden per patient compared to income, it does go along with a strongly increased use of generic drugs. A likely contributor is that the government's initiative to promote generic substitution alloyed concerns about quality on the part of both prescribers and patients.

The variation in deductibles and coinsurance permits to study the interaction between physicians' financial incentives and their patient agency. Given imperfect agency on behalf of patients, dispensing physicians are predicted to respond less strongly to a hike in copayment than non-dispensing ones (Hypothesis 4). However, the evidence found in our data is mixed, failing to support the notion that drug dispensing weakens physician agency, as argued by pharmacists' lobbying groups and some Swiss politicians.

Moreover, most of the odds ratios pertaining to proxies of patient income (residence in a high-income area, purchase of extra hospital and accident insurance) suggest that wealthier patients have a higher probability of receiving brand-name drugs because the price difference between them and the generic substitute has less of an effect due to lower marginal utility of income of the wealthy (Hypothesis 3).

Consideration of the savings for insurers might provide an additional motivation for the prescription of the cheaper generic alternative (Hypothesis 5). However, this effect could be confirmed for only one drug in the econometric estimation (see Table 5.2 again). Nevertheless, the high willingness of non-dispensing physicians to prescribe generic drugs points to some degree of agency towards insurers. Last but not least, physicians working in managed care-type arrangements are found to prescribe more generic drugs than their colleagues, pointing to an increased cost awareness in the managed care setting (Hypothesis 6).

In sum, financial incentives, agency towards the patient, and agency towards insurers are all found to markedly influence generic substitution. Moreover, government initiatives to promote generic drugs can be effective even in the presence of weak financial incentives because they may reassure physicians and patients of the safety and high quality of generic drugs. However, if government were to try to markedly reduce generic prices, it might weaken the incentives for generic substitution, at least for dispensing physicians. The reason is that physicians' financial incentives may encourage rather than undermine generic substitution.

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DO DISPENSING PHYSICIANS OPTIMIZE THEIR OWN DRUG MARGINS? EVIDENCE FROM SWITZERLAND

BY
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SUMMARY

While some countries separated drug prescription and dispensation to ensure independent drug choice, others allow combined providers to increase pharmaceutical access or the utilization of pharmacist skills. A drawback is that combined providers may be incentivized to increase profits through the prescription of cost-inefficient packages. Switzerland constitutes an interesting example where dispensing and non-dispensing physicians coexist permitting a comparison of their prescribing behavior. The paper shows how margin optimization is possible under the current price regulation and finds that dispensing physicians' margin per dose is between 5 and 10 while cost per dose are between 3 and 5 percent higher.

Chapter 6

Do Dispensing Physicians Optimize Their Own Drug Margins? Evidence from Switzerland

6.1 Introduction

By law, in order to prevent financial incentives affecting the way prescriptions are issued, many countries separate drug prescription and drug dispensation. Critics accuse combined providers – dispensing physicians or prescribing pharmacists – of being influenced by personal profit considerations when choosing a drug or drug quantity. South Korea demonstrates one example where physician dispensing and pharmacy prescribing was allowed until 2000, but was separated thereafter to tackle inefficient drug allocation and consumption [see Soonman (2003)]. On the other hand, combining drug prescription and dispensation permits an increase in pharmaceutical access across rural areas or makes greater use of pharmacists' skills to improve system flexibility with respect to prescribing, supply, and administration of medicines [see Tonna et al. (2007)]. The former is the reason why physician dispensing is allowed in some Swiss jurisdictions, while the latter explains why pharmacy prescribing was introduced in the United Kingdom where patients face long waiting times to see a doctor [see

Pearson et al. (2001)]. For similar reasons, pharmacist prescribing was successfully introduced in the United States, Canada, and New Zealand [see Emmerton et al. (2005)]. Therefore, policy makers have to balance the advantages of combined drug provision against its potential disadvantages.

Potential disadvantages of combining drug prescription and dispensation emerge for different reasons. Providers serve as agents for their clients making diagnoses and prescribing the most adequate drugs and drug quantities. If they act as perfect agents they make the same decisions as their patients under full information [see Zweifel et al. (2009), Chapter 8]. However, the relationship between drug providers and their patients (or insurers where health insurance covers drug expenditure) is characterized by a strong information asymmetry. Economic incentives may seduce them to deviate from their role as perfect agents leading to a misallocation of resources. Therefore, it is important to investigate if there are differences in the prescribing behavior of combined and separated providers and to explore if pharmaceutical pricing mechanisms set financial incentives that are strong enough to entrap providers to optimize their drug margins.

In most countries, health care markets are heavily regulated and public authorities administrate pharmaceutical prices. In some countries like Switzerland, drug prices are regulated on manufacturer levels and so-called logistic margins are added to cover the cost of drug provision for dispensing physicians or pharmacies, e.g. storage costs. Logistic margins are often composed of two components: a certain amount per package and an additional contribution which depends on the manufacturer price. In Switzerland, particularly, the per package component is under considerable strain because it permits dispensing physicians to increase their own profit by reducing package size and increasing the number of packages.

The objective of this analysis is to investigate whether combining drug prescription and dispensation leads to margin optimization activities under a pharmaceutical pricing mechanism that contains a package price component. The paper is structured as follows. Section 6.2 pictures the health care system and pharmaceutical pricing in

Switzerland. Section 6.3 examines the theoretical optimal size of a package for margin optimizing combined providers. It reveals that the package component likely incentivizes combined providers to conduct margin optimization. Section 6.4 turns to the empirical part of the analysis and outlines how margin optimization is measured for Swiss dispensing physicians. Section 6.5 describes the used drug claims data and Section 6.6 the estimation results that indicate the margin optimization of dispensing physicians. Finally, Section 6.7 concludes.

6.2 Institutional background

The health care system in Switzerland is financed through lump sum premiums that are independent of income. Purchasing health insurance is mandatory for all citizens while low-income individuals are subsidized through premium reductions. Every year, an individual can choose one of six deductible levels ranging between CHF 300 and 2,500 (1 CHF $\approx$ 1.1 USD at 2011 exchange rates) for the following year. Opting for a higher deductible is rewarded with a lower premium and is in general chosen by healthier individuals. In the case of annual health care expenditures exceeding the deductible, insured individuals have to bear a copayment of 10 percent up to a total payment of CHF 700. For expensive brand-name drugs with at least one bioequivalent generic competitor, the copayment rate was increased from 10 to 20 percent in January 2006. All brand-name drugs explored in this study faced such an increase in 2006, but they bought their way out by reducing their prices during the study period.

New pharmaceuticals have to be approved by Swissmedic, an independent epidemiological institute. After the authorization, the Federal Office of Public Health (FOPH) decides upon the three criteria effectiveness, safety, and adequacy if they are set on the positive list of drugs that have to be reimbursed by health insurers. The FOPH is in charge of pharmaceutical pricing through direct price regulation [see Bauer (2001)]. In a first step, the FOPH negotiates with producers about the manufacturer price for the smallest package provided. This price represents the reference for the pricing of larger packages. The manufacturer price constitutes the maximum price at which producers are allowed to sell their products to dispensing physicians, pharmacists, and wholesalers. While brand-name drugs are priced with the aid of an international price reference system, generic drug prices are set at least 40 percent below its bioequivalent brand-name drug. If both parties agree on the reference price, manufacturer prices (P) for different package sizes and dosages are determined, following the regulated price relations for different package sizes and dosages (see Table 6.6 in the Appendix).

Based on P, a so-called logistic drug margin (M) for pharmacies, dispensing physicians, and wholesalers is added to cover the cost of drug delivery. The logistic drug margin is a combination of a fixed per package margin (m_f) and a variable capital margin (m_v) that is calculated as a percentage of P. The per package margin increases in increments depending on the manufacturer price category. The capital margin m_v is between 12 and 15 percent for drugs cheaper than CHF 800, and between 8 and 10 percent for prices between CHF 800 and 1,800. Pharmaceuticals with a manufacturer price above CHF 1,800, distribution costs are fully reimbursed through a package margin of CHF 240. The values for m_f and m_v are given in Table 6.1.

Manufacturer price (*P*)	**Logistic margin (*M*)**		**Manufacturer price (*P*)**	**Logistic margin (*M*)**	
	m_f	m_v		m_f	m_v
CHF 00.00-04.99	CHF 04.00	12-15%	CHF 15.00-799	CHF 16.00	12-15%
CHF 05.00-10.99	CHF 08.00	12-15%	CHF 800.00-1,799	CHF 60.00	08-10%
CHF 11.00-14.99	CHF 12.00	12-15%	CHF $\geq$1800	CHF 240.00	

Source: Drabinski et al. (2008) (1 CHF ≈ 1.1 USD at 2011 exchange rates).

Table 6.1: Logistic drug margins in Switzerland

Patient (or sales) prices paid by either patients or health insurers are the sum of P and M and for simplicity, called drug cost (C) for the remainder of this paper. In fact, only C is observed in the drug claims data. The true (unofficial) drug margin may differ if dispensing physicians or pharmacists are able to buy drugs below P, e.g. because of marketing activities of pharmaceutical representatives. Further, how the drug margin M is split between producers, wholesalers, pharmacists, and dispensing physicians is not regulated and the outcome of a bargaining between the market participants. Therefore, neither the FOPH, nor insurers, nor patients know exactly drug providers' profit from drug dispensing. In addition, pharmacists are allowed to charge payments directly to the patient for checking the medication and assessing the accuracy of the treatment, as well as to cover the cost of recording the medication. It is strictly forbidden for dispensing physicians to charge these fees because they are already paid for these services through fee-for-service. If not explicitly prohibited by the physician, pharmacists are allowed to substitute brand-name drugs with generics, receiving a share of insurer's cost savings to promote generic substitution [see Drabinski et al. (2008)]. A reader interested in a more detailed discussion of the Swiss pharmaceutical market is referred to Hunkeler (2007) and Hunkeler (2008) for a historic review.

Table 6.1 shows that m_f is relatively high compared to P, especially for cheaper drugs. This pricing mechanism may incentivize dispensing physicians to reduce package size and prescribe a higher number of packages.

The next section shows theoretically, how combined drug providers – dispensing physicians or prescribing pharmacists – could exploit the design of the logistic drug margin to optimize their own profits.

6.3 Theoretical drug margin optimization

This section uses microeconomic theory to analyze potential drug margin optimization by adjusting package size. Starting with the general optimization problem of combined providers, the focus then turns to drug margin optimization with respect to the number of packages prescribed and package size. The section ends with real data examples that illustrate the potential increase in profit through optimization (see Table 6.2 and Figure 6.1).

The decision-making process of a prescriber starts with choosing the best active pharmaceutical ingredient, selecting a specific brand, indicating patient's required total dosage (D_t), and finally deciding how to prescribe D_t with respect to the number of packages (N), number of pills per package (S), and dosage per pill (D). Acting as a perfect agent on behalf of the drug payer would require the prescription of the most cost-efficient combination of N, S, and D available for delivering D_t. Combined providers optimize their logistic margin by solving the following optimization problem,

$$\begin{aligned} \max_{N,S,D} \; & M = N \cdot \Big[m_f(P(S,D)) + m_v(P(S,D)) \cdot P(S,D) \Big] \\ s.t. \; & N \cdot S \cdot D = D_t. \end{aligned} \tag{6.1}$$

The quantity D_t denotes the total amount of dosage to be prescribed and is assumed to be constant because supplier-induced demand is neglected [see McGuire (2000) for a discussion of supplier-induced demand in health care]. The package (m_f) as well as the capital (m_v) margin components depend on the manufacturer price (P). According to pharmaceutical pricing in Switzerland, m_f is defined as a discrete step-function depending on the price category of the drug. Because only a small fraction of investigated drugs are cheaper than CHF 15 and all cheaper than where m_v starts to change, m_f and m_v are assumed to be constant. Without this simplification, e.g. prescribing two packages to double m_f could lead to the same contribution because m_f halves. Again, a change of price category is unlikely for the drugs explored in this study. The manufacturer price is assumed to have the following functional form

$$P(S,D) = p_C + p_S(S)S + p_D(D)D, \tag{6.2}$$

where p_C represents the price constant and manufacturer prices increase with package size and dosage ($\partial P/\partial S > 0$ and $\partial P/\partial D > 0$), but at a decreasing rate ($\partial^2 P/\partial S^2 < 0$ and $\partial P^2/\partial D^2 < 0$).

6.3.1 Choice of package size

Again, it is assumed that the total amount of dosage ($D_t > 0$) does not change due to supplier-induced demand. For simplicity, D is assumed to be given exogenously depending on the patient's need so that it does not affect the optimization and leaves us with a two-dimensional optimization problem. Furthermore, all quantities are treated as continuous even if they are discrete in practice, e.g. reducing package size by one pill is not possible in practice because prescribers can only choose from available packages.[1] Then, P does only change with S and the price function given by Equation (6.2) simplifies to $P(S|D) = c_D + p_S(S)S$, where $c_D = p_C + p_D D$ is the dosage-specific constant. In combination with Equation (6.1), we can derive how the logistic drug margin (M) changes with N and S, respectively.[2] The optimization problem is given by

$$\begin{aligned} \max_{N,S}\ & M|D_t, D = N \cdot \Big[m_f + m_v(c_D + p_S(S)S) \Big] \\ s.t.\ & N = D_t/SD. \end{aligned} \tag{6.3}$$

Substituting the quantity constraint into the margin function, the problem reduces to

$$\max_{S}\ M|D_t, D = \frac{D_t}{SD} \cdot \Big[m_f + m_v(c_D + p_S(S)S) \Big]. \tag{6.4}$$

Taking the first derivative of drug margin M with respect to package size S leads to $\partial M/\partial S = -(m_f + m_v c_D)D_t S^{-2} D^{-1} + m_v D_t D^{-1}(\partial p_S/\partial S)$ and rearranging the expression to simplify interpretation leads to

$$\frac{\partial M}{\partial S} = -\frac{(m_f + m_v c_D)N}{S} + m_v NS(\partial p_S/\partial S) < 0 \tag{6.5}$$

because $\partial p_S/\partial S \leq 0$.[3] Therefore, drug margin is strictly monotonic decreasing in package size, no matter if drug prices are discounted with package size or not and the maximization problem leads to the corner solution where the smallest package is prescribed which is available to prescribe D_t (S=7 in Figure 6.1). Equation (6.5) unveils the role

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[1] In some countries, drugs are sold by patient-specific package sizes containing the exact number of pills needed.

[2] The logistic drug margin constitutes physicians' net profit from drug dispensing being the difference between the reimbursed sales (or patient) price and the manufacturer price (provider's purchasing cost).

[3] Note that in Switzerland prices are discounted with increasing package size so that $\partial p_S/\partial S < 0$ leading to $\partial M/\partial S < 0$.

pharmaceutical pricing plays in the optimization problem. Increasing m_f raises the incentive to decrease package size for more packages.

Conclusion 1: Pharmaceutical pricing in Switzerland permits dispensing physicians to increase their own profits by reducing package size in return for a higher number of packages because $\partial M/\partial S < 0$.

The second derivative shows that $\partial^2 M/\partial S^2 = (m_f + m_v c_D) D_t D^{-1} S^{-3} > 0$ if we assume a pharmaceutical pricing with $\partial^2 p_S/\partial S^2 = 0$, which is satisfied in the case of Switzerland (see Table 6.6 in the Appendix). Thus, margin optimization is more effective in the lower domain of S.

Conclusion 2: A marginal decrease in package size leads to a higher increase in the logistic drug margin for smaller packages ($\partial^2 M/\partial S^2 > 0$) as long as prices do not switch categories and therefore, m_f decreases.

In addition to the incentive arising from the design of the logistic drug margin, raising discount rates for larger packages makes the expression $\partial p_S/\partial S$ in Equation (6.5) stronger negative. Hence, optimization is partly induced by price discounts because reducing package size permits to increase the manufacturer price per prescribed dosage, which then translates into a higher logistic drug margin.

Conclusion 3: Discounting pharmaceutical prices with increasing package size permits Swiss dispensing physicians to rise manufacturer price per dose by prescribing smaller packages. If drug pricing is linear in package size, i.e. $\partial p_S/\partial S = 0$, no such additional effect is present.

The logistic drug margin given by Equation (6.4) is depicted in Figure 6.1. The relevant parameters for the brand-name drug of omeprazole were estimated using prices of January 2006. The graph visualizes Conclusions 1 and 2 showing that the drug margin increases if S is reduced and therefore N increases. For D=20 (solid line), the values coincide with the margins discussed next and displayed in Table 6.2.

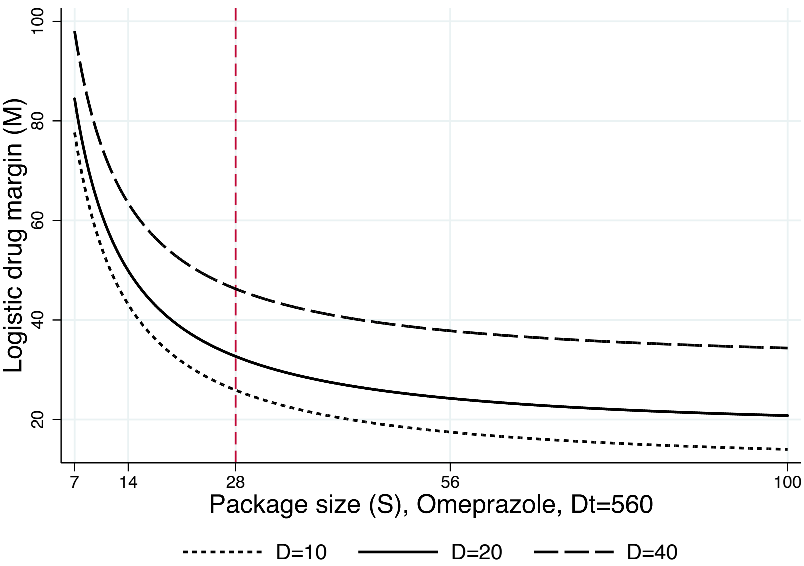

Figure 6.1: Drug margin as a function of package size for given D_t and D

6.3.2 An example of margin optimization

To illustrate package size optimization, a patient in need of 20 mg omeprazole per day for four weeks (28 days) in January 2006 is assumed, i.e. D_t=560 and D=20.[4] The most cost-efficient prescription (and lowest margin and cost per dose) is given by S=28, D=20, N=1 resulting in a drug margin of CHF 33 and cost of CHF 126.[5] Instead, two packages with S=14 could be prescribed increasing patient's cost to CHF 146 and dispenser's drug margin to CHF 50, an increase in profit of CHF 17 (or 52 percent). In the extreme case that may be less likely, prescribing S=7 and N=4 increases drug margin to CHF 85 and cost to CHF 194. Hence, current pharmaceutical price and margin regulation in Switzerland permits to more than double profit selling omeprazole by optimizing package size (CHF 33 versus 85). Therefore, margin optimization can substantially affect profits leading to conflicts of interest for combined providers. Table 6.2 displays logistic drug margins for the outlined example and four generics. Logistic drug margins could also be optimized by reducing the dosage per pill (D) in return

[4] This example is chosen because it represents the most frequently prescribed package for omeprazole.

[5] The logistic drug margin is calculated neglecting value added taxes.

		Antra MUPS		**Omezol-Mepha MT**		**Omed**		**Oprazol**		**Omeprazole Helvepharm**	
S	N	M	Δ	M	Δ	M	Δ	M	Δ	M	Δ
28	1	32.82	1.00	22.52	1.00	22.47	1.00	25.20	1.00	21.35	1.00
14	2	49.92	1.52	38.10	1.69	38.01	1.69	41.10	1.63	29.10	1.36
7	4	84.96	2.59	57.00	2.53	–	–	–	–	39.00	1.83

Note: Logistic drug margins are shown in CHF (1 CHF ≈ 1.1 USD at 2011 exchange rates). Relative changes are denoted by Δ. Omed was renamed to Omeprazol Sandoz Eco later on.

Table 6.2: Example of relative changes in logistic drug margins ($D_t = 560,\ D = 20$)

for a higher number of packages (keeping package size constant). But this seems less realistic in practice because D cannot be manipulated that easy.

6.4 Econometric analysis

This section outlines the strategy how drug margin optimization is estimated empirically. Subsection 6.4.1 discusses the two dependent variables used to estimate optimization activity and its effect on pharmaceutical expenditure. Subsection 6.4.2 turns to the explanatory variables included in the regression analysis, while Subsection 6.4.3 discusses the estimated econometric model.

6.4.1 Logistic drug margin and drug cost variables

Logistic drug margin optimization by dispensing physicians is investigated comparing margin-per-dose (MPD) values of dispensing physicians and pharmacies. Aggregating the MPD on patient level instead of comparing MPD values on prescription level accounts not only for margin optimization for single physician visits but also over time. If drug brand changes for a patient over time, observations are treated separately. On the one hand, this controls for different manufacturer prices. On the other hand, aggregation is less problematic because it is likely that the change is due to a change in drug seller, e.g. change from a physician to a pharmacy. However, if aggregation does not lead to complete combined or separated drug provision, observations are treated as from combined providers if two-thirds of D_t is sold by a physician. The MPD for aggregated observation n is then given by

$$\mathrm{MPD}_n = \sum_i (m_{f,i} + m_{v,i}P_i)S_i^{-1}D_i^{-1} \tag{6.6}$$

for all single observations i that belong to the same physician, patient, and drug.[6]

Drug cost per dose (CPD) is used to measure the effect of physician dispensing on drug expenditure. The CPD values aggregate profits for drug dispenser (dispensing physician or pharmacy) and producer. They are calculated as

$$\mathrm{CPD}_n = \sum_i C_i S_i^{-1} D_i^{-1}, \tag{6.7}$$

where $C_i = m_{f,i} + (1 + m_{v,i})P_i$ represents drug expenditure with respect to a single prescription i.[7]

It is important to keep in mind that even if there is a positive correlation between combining drug provision and CPD, combined drug delivery may be more cost-efficient due to savings elsewhere, e.g. generic substitution [see Rischatsch et al. (2010)]. However, assessing overall cost-efficiency of physician dispensing is not the objective of this study. Readers interested therein are referred to Trottmann (2011).

There are many factors that affect the outcome variables. While some of them are under the prescriber's control, others are not. Inference may be confounded if the latter are omitted. The next subsection discusses the covariates included in the regression analysis.

6.4.2 Explanatory variables

Drug margin optimization is tested using a dummy variable being one for combined drug provision and zero otherwise. In Switzerland, physician dispensing (PD) repre-

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6 N_i cancels out of the equation because prescriptions of different packages at the same time are treated as separate observations.

7 Again, additional fees and taxes that are either small or do not differ between combined and separated providers are neglected.

sents combined drug provision. Thus, the analysis includes a PD-dummy to indicate combined drug provision. A statistically significant and positive coefficient pertaining to PD points at margin optimization activities and imperfect agency on behalf of the payer.

As mentioned above, there are several factors affecting the outcome variables. General practitioners (GPs) may face patients with different needs than specialists. Hence, a GP-dummy is included to control for these differences. Moreover, physicians who prescribe some substances very rarely may be less informed about available package sizes and dosages. Even if the investigated drugs are blockbusters, information may affect MPD and CPD without being correlated with margin optimization activities. Including the number of prescriptions might be problematic because it can be correlated with margin optimization. In contrast, using the number of patients (NPA) a physician faced during the study period is independent of optimization efforts if one assumes supplier-induced demand to be absent. Furthermore, facing a higher demand for a specific substance may result in a larger drug portfolio in private-practice pharmacies. Having different packages available permits to prescribe more cost-efficient.

Patients' health insurance plans are used to control for heterogeneity among patients. In Switzerland, an insured can choose between different deductibles every year (see Section 6.2). Choosing a high deductible correlates with patients' expectation of low need for health services in the following year. Patients with e.g. chronic diseases most likely choose the lowest deductible. Therefore, it is important to distinguish between these groups because patients in need of a high total dosage can be provided with more cost-efficient packages due to price discounts for large packages. Hence, patients' latent health status is modeled using dummy variables for different deductible categories. The lowest deductibles of CHF 300 or 500 serve as the reference category. Patients with a deductible of CHF 1,000 or 1,500 are grouped into medium deductible patients (DEDM) and those with the highest deductibles of CHF 2,000 or 2,500 are represented by the high deductible category (DEDH). Additionally, individuals opting for a health maintenance organization (HMO) contract and physicians working in HMO practices are expected to be more cost-aware increasing cost-efficiency. The same might be the case for gatekeeping insured people (GATE). To control for demographic effects, patient's age (AGE) and gender (MALE) is included. The RUR dummy captures differences between urban and rural located practices and the FRIT dummy incorporates differences between French-/Italian- and German-speaking areas.

Aggregation on patient levels to model margin optimization over time requires a time-indicator that permits to link outcome variables with price changes over time which directly affect MPD and CPD values. Calculating the shares of prescriptions for each year solves this problem. Hence, two year variables are included, one for 2006 (Y06) and one for 2007 (Y07), where 2005 constitutes the reference category.[8]

Rischatsch et al. (2010) show that financial interests encourage dispensing physicians to substitute brand-name by generic drugs. In contrast to optimizing drug choice, the present study is interested in how the combination of prescription and dispensation affects package choice given a particular drug was chosen. Therefore, drug-specific constants (DSCs) are included to control for different manufacturer prices across pharmaceuticals. Omitting drug choice would underestimate dispensing physicians' MPD due to a higher market share of generics with lower logistic drug margins. Again, the present study is interested in separating such effects. Further, DSCs control for additional unobserved drug-specific effects.

The estimation equation can be written as

$$\begin{aligned} y &= \beta_0 + \beta_1 \text{PD} + \beta_2 \text{GP} + \beta_3 \text{NPA} + \beta_4 \text{DEDM} + \beta_5 \text{DEDH} + \beta_6 \text{HMO} \\ &\quad + \beta_7 \text{GATE} + \beta_8 \text{AGE} + \beta_9 \text{MALE} + \beta_{10} \text{RUR} + \beta_{11} \text{FRIT} + \beta_{12} \text{Y06} \\ &\quad + \beta_{13} \text{Y07} + \beta_{14} \text{DSC1} + \beta_{15} \text{DSC2} + \beta_{16} \text{DSC3} + \beta_{17} \text{DSC4} + \varepsilon \end{aligned} \tag{6.8}$$

where $y \in \{\text{MPD, CPD}\}$ and ε denotes the error term.

[8] Controlling for the share of dosage per year is problematic because it is already used for the calculation of the dependent variable.

6.4.3 Model specification

The estimation of MPD and CPD values using ordinary least squares (OLS) regressions can be problematic because the data are non-negative and most often heavily skewed so that assumed normally distributed errors are inappropriate and might lead to meaningless negative predictions. A possible solution to this is to transform the dependent variable and run an OLS on the transformed variable. The model proposed by Box and Cox (1964) can be used to find the optimal transformation. The Box-Cox transformation of the dependent variable leads to the estimation equation $(y^{\lambda} - 1)\lambda^{-1} = x\beta + \varepsilon$, where λ is estimated simultaneously with β. In the limiting case where λ is zero, the left-hand side of the expression reduces to $ln(y)$. The disadvantage of the Box-Cox model is that the β's are not interpretable without a re-transformation to the raw-scale. In the presence of heteroscedasticity, this can be problematic and lead to biased estimates.

The generalized linear models (GLMs) approach serves as an alternative. The great advantage of these models is that no re-transformation to the raw-scale is required after the estimation [see Manning (1998), Manning and Mullahy (2001)]. A GLM is defined through its link function $g(\cdot)$ and the distributional family of the dependent variable $F(y)$. The link function defines the relation between the expected outcome $E[y|x]$ and the linear predictor $x\beta$, so that $g(E[y|x]) = x\beta$. The most prominent functions are the logarithmic $[ln(y) = x\beta]$ and inverse link function $[y^{-1} = x\beta]$. The optimal link function depends on the data and can be found using the Box-Cox model discussed previously. The distributional family $F(y)$ defines the relation between the mean and variance of the dependent variable. Manning and Mullahy (2001) recommend to use the test proposed by Park (1966) to find the optimal mean-variance relation for the data at hand. In this study, gamma family and logarithmic link function is found to represent the data best.

The GLMs in this study are estimated using Bayesian econometrics. The joint posterior $K(\theta|Y)$ is computed by Bayes theorem and links the observed data (Y) with the researcher's expectations about the unknown parameters (θ) so that

$$K(\theta|Y) = \frac{L(Y|\theta) \cdot k(\theta)}{L(Y)}, \tag{6.9}$$

where $L(Y|\theta)$ is the likelihood of observing Y given θ, $k(\theta)$ is the prior about θ, and $L(Y)$ is the normalizing constant. The denominator is independent of θ and can be dropped resulting in $K(\theta|Y) \propto L(Y|\theta) \cdot k(\theta)$ which is the product of the likelihood times the prior distribution. For the gamma GLM, the likelihood is given by $\Gamma(\mu\tau, \tau)$, where Γ denotes the gamma distribution with its scale and shape parameters. The logarithmic link function enters the model as $ln(\mu) = X\beta$, where X is the covariate matrix. Then, $\theta = \{\beta, \tau\}$ are the unknown parameters of interest. Here, τ is the likelihood's precision parameter which is equivalent to the inverse of the variance ($\tau = \sigma^{-2}$) and is assumed to have a gamma prior, i.e. $\tau \sim \Gamma(a_\tau, b_\tau)$. Physician-specific estimates (β_p) are obtained by specifying a hierarchical structure for the Bayes model so that β is replaced by $\beta_p = \bar{\beta} + \delta_p$, where $\bar{\beta}$ represents the population mean effect of β and δ_p represents the difference in the effect between physician p and the population mean with $E[\delta_p] = 0$. Normal priors are assumed on the lower hierarchical stage so that $\bar{\beta} \sim N(\mu_{\bar{\beta}}, \tau_{\bar{\beta}})$ and $\delta_p \sim N(0, \tau_\delta)$ and the hyperprior for τ_δ on the upper level of hierarchy is assumed to be gamma distributed with $\tau_\delta \sim \Gamma(a_\delta, b_\delta)$. All prior and hyperprior parameters are chosen to make the priors as uninformative as possible so that their choice does not affect the estimates. However, with the large data set to be analyzed, the weight of assumed priors diminishes so that their choice is not influential. The joint posterior is then given by

$$\begin{aligned} K(\bar{\beta}, \delta_p \forall p, \tau_\delta, \tau|Y) \ \propto \ & \prod_p \Gamma(Y|\mu\tau, \tau) \times N(\bar{\beta}|\mu_{\bar{\beta}}, \tau_{\bar{\beta}}) \times N(\delta_p|0, \tau_\delta) \\ & \times \Gamma(\tau_\delta|a_\delta, b_\delta) \times \Gamma(\tau|a_\tau, b_\tau) \end{aligned} \tag{6.10}$$

which has no standard distribution and has to be simulated. To facilitate the computation due to large data sets and high number of parameters to estimate, only the coefficient pertaining to PD is modeled with a hierarchical structure.

6.5 Data

To test for margin optimization, three active pharmaceutical ingredients from therapeutic categories with high sales volume are selected: omeprazole, amlodipine, and ciprofloxacin [see Hunkeler (2008)].[9] The drug claims data were provided by a major Swiss health insurer and contain prescription-level observations between 2005 and 2007. Omeprazole is an inhibitor of gastric acid secretion and used to treat gastric and duodenal abscesses while amlodipine is a calcium channel blocker for treating angina, and ciprofloxacin is used to treat specific bacterial infections.[10]

A first univariate comparison of logistic drug margin per dose between dispensing physicians and pharmacies shows that mean and median MPD values are higher for dispensing physicians regardless of substances.[11] For omeprazole and amlodipine, the data reveal a negative correlation between PD and CPD.[12] This can be explained by the higher share of generics dispensed by physicians and underlines the importance of including DSCs in the regression to separate drug choice from margin optimization.

Three additional measures permit a first impression of prescribing behavior regarding package choice. On average, dispensing physicians sell a higher number of packages to provide the median dosage per patient needed. For omeprazole, dispensing physicians prescribe 2.3 packages versus 1.9 packages by non-dispensing physicians. The values for amlodipine are 3.5 versus 3.3 and for ciprofloxacin 1.1 versus 1.0. This is in line with the average package size prescribed. On average, omeprazole is prescribed through packages containing 34.6 pills (dispensing physicians) versus 42.4 pills (non-dispensing

[9] ATC-codes: omeprazole (A02BC01), amlodipine (C08CA01), ciproflocaxin (J01MA02)

[10] For more information see www.drugbank.ca/drugs

[11] Mean MPD (in CHF per 1,000 mg) for physicians versus pharmacies: 40.0 versus 37.6 (omeprazole), 53.1 versus 52.1 (amlodipine), and 4.1 versus 3.9 (ciprofloxacin).

[12] Mean CPD (in CHF per 1,000 mg) for physicians versus pharmacies: 101.1 versus 101.7 (omeprazole), 155.8 versus 158.5 (amlodipine), and 9.0 versus 8.8 (ciprofloxacin).

physicians). The same tendency can be observed for amlodipine (84.5 versus 87.6) and ciprofloxacin (12.7 versus 14.4) backing the hypothesis that dispensing physicians prescribe smaller packages. In contrast, average dosage per pill is higher for dispensing physicians.

	Omeprazole			**Amlodipine**			**Ciprofloxacin**		
	MN	MD	SD	MN	MD	SD	MN	MD	SD
Physician dispensing (PD)	0.39	0.00	0.49	0.45	0.00	0.50	0.52	1.00	0.50
General practitioner (GP)	0.81	1.00	0.39	0.86	1.00	0.34	0.77	1.00	0.42
Number of patients (NPA)	71	30	109	32	16	47	32	15	47
Medium deduc.(DEDM)	0.06	0.00	0.24	0.03	0.00	0.17	0.09	0.00	0.29
High deduc. (DEDH)	0.01	0.00	0.11	0.01	0.00	0.08	0.02	0.00	0.14
HMO insured (HMO)	0.04	0.00	0.20	0.02	0.00	0.14	0.02	0.00	0.15
Gatekeeping ins. (GATE)	0.05	0.00	0.23	0.04	0.00	0.20	0.06	0.00	0.24
Patient age (AGE)	58	59	18	70	72	13	57	59	19
Patient sex (MALE)	0.39	0.00	0.49	0.47	0.00	0.50	0.41	0.00	0.49
Rural area (RUR)	0.25	0.00	0.43	0.27	0.00	0.44	0.25	0.00	0.43
French/Italian (FRIT)	0.45	0.00	0.50	0.33	0.00	0.47	0.34	0.00	0.47
Share in 2006 (Y06)	0.33	0.00	0.42	0.30	0.20	0.36	0.35	0.00	0.46
Share in 2007 (Y07)	0.41	0.18	0.45	0.32	0.00	0.39	0.37	0.00	0.47
Share of generic 1 (DSC1)	0.38	0.00	0.49	0.31	0.00	0.46	0.34	0.00	0.47
Share of generic 2 (DCS2)	0.37	0.00	0.48	0.19	0.00	0.39	0.27	0.00	0.44
Share of generic 3 (DSC3)	0.10	0.00	0.30	0.09	0.00	0.29	0.18	0.00	0.38
Share of generic 4 (DSC4)	0.07	0.00	0.25	0.06	0.00	0.24	0.04	0.00	0.19

Note: Descriptives are mean (MN), median (MD), and standard deviation (SD)

Table 6.3: Descriptive statistics

Descriptive statistics for the explanatory variables are shown in Table 6.3. The share of sampled observations (not prescriptions) pertaining to dispensing physicians is between 39 and 52 percent. Hunkeler (2008) estimates an physician-dispensing rate of 33 percent for all prescriptions covered by Swiss social health insurance. The high share emphasizes the important role of PD in delivering pharmaceuticals. GPs prescribe more than 77 percent of the sampled prescriptions. On average, physicians face 32 patients in need of amlodipine and ciprofloxacin, and 71 patients requiring omeprazole. About 90 percent of sampled patients have chosen the lowest deductible category while between 3 and 9 percent signed a medium (DEDM) and between 1 and 2 percent signed a high

(DEDH) deductible contract. Only 2 to 4 percent are HMO insured and between 4 and 6 percent signed a gatekeeping contract. Patients' average age is 58 (omeprazole), 70 (amlodipine), and 57 (ciprofloxacin). Between 39 and 47 percent of sampled patients are male. About a quarter of all practices are located in rural areas and between 33 and 45 percent are in French- or Italian-speaking areas. Prescriptions are distributed equally over the three years. The DSCs display drug-specific shares of aggregated observations where the brand-name drug is the base category.

6.6 Estimation results

Posterior summaries for the hierarchical Bayes GLM estimates with respect to the margin per dose (MPD) are listed in Table 6.4. As proposed by the Box-Cox model, logarithmic link functions are applied for all three chemical agents which has further advantages in that the coefficients can be interpreted as semi-elasticities (ξ), e.g. as the percentage change in MPD for a change from separated (PD=0) to combined (PD=1) drug provision.

6.6.1 Differences in margin-per-dose values

In this study, the PD variable is the one of main interest to assess if selling drugs on their own account leads to margin optimization activities. The posterior means for PD show that the logistic margin per dose is 10.1 percent higher for omeprazole, 5.6 percent higher for amlodipine, and 5.2 percent higher for ciprofloxacin. All 95%-credibility intervals do not include zero and the lowest 2.5 percentile is found for ciprofloxacin (4 percent) while the highest 97.5 percentile is found for omeprazole (11 percent). These values point at margin optimization activities by dispensing physicians. The upper panel of Figure 6.2 depicts Kernel densities of physician-specific semi-elasticities (ξ_p) for physician dispensing. The physician-specific coefficients indicate that a share of 85 to 89 percent of the sampled physicians reveal a positive ξ_p underpinning that the effect is found for a major share of prescribers. However, there is heterogeneity in the ξ_p's

MPD	**Omeprazole**			**Amlodipine**			**Ciprofloxacin**		
Posterior	mean	percentiles		mean	percentiles		mean	percentiles	
		2.5	97.5		2.5	97.5		2.5	97.5
PD	0.10	0.09	0.11	0.06	0.05	0.07	0.05	0.04	0.06
GP	0.00	-0.01	0.01	-0.02	-0.03	-0.01	0.02	0.01	0.03
NPA	0.02	0.01	0.02	-0.02	-0.03	-0.02	0.02	0.01	0.02
DEDM	0.06	0.04	0.07	0.07	0.05	0.09	0.00	-0.00	0.01
DEDH	0.08	0.06	0.11	0.09	0.05	0.14	0.01	-0.01	0.03
HMO	0.02	-0.00	0.04	-0.03	-0.06	-0.00	-0.02	-0.04	-0.01
GATE	0.01	-0.01	0.02	0.02	-0.00	0.03	0.00	-0.01	0.01
AGE	-0.08	-0.08	-0.07	0.00	-0.00	0.00	-0.00	-0.01	-0.00
MALE	-0.05	-0.05	-0.04	-0.07	-0.07	-0.06	-0.11	-0.12	-0.11
RUR	-0.00	-0.01	0.01	0.00	-0.00	0.01	0.00	-0.00	0.01
FRIT	0.02	0.01	0.03	0.01	0.00	0.02	-0.03	-0.03	-0.02
Y06	-0.03	-0.04	-0.02	-0.19	-0.20	-0.18	-0.11	-0.11	-0.10
Y07	-0.08	-0.09	-0.07	-0.31	-0.32	-0.30	-0.14	-0.14	-0.13
DSC1	-0.31	-0.32	-0.30	-0.16	-0.17	-0.15	-0.12	-0.12	-0.11
DSC2	-0.36	-0.37	-0.34	-0.21	-0.22	-0.20	-0.09	-0.09	-0.08
DSC3	-0.49	-0.51	-0.47	-0.19	-0.21	-0.18	-0.09	-0.10	-0.08
DSC4	-0.54	-0.56	-0.52	-0.25	-0.26	-0.23	-0.15	-0.17	-0.14
CONST	3.98	3.96	3.99	4.23	4.22	4.24	1.57	1.56	1.58
Number of observations			72,488			40,749			66,236
Number of physicians			7,314			5,919			7,675
Specification: gamma GLM family (F) with logarithmic link function (g)									

Note: To facilitate simulation, the two explanatory variables number of patients (NPA) and patient age (AGE) were standardized to have $E[x] = 0$, $Var[x] = 1$.

Table 6.4: Margin-per-dose estimates – hierarchical Bayes GLM results

ranging from -14 to 39 percent (omeprazole), -8 to 24 percent (amlodipine), and -18 to 30 percent (ciprofloxacin).

The estimates pertaining to the GP variable show no evidence for differences in the prescribing behavior between general practitioners and specialists. While the 95%-credibility interval includes zero in the case of omeprazole, the interval for amlodipine is located in the positive while the one for ciprofloxacin lies in the negative domain only. The same conclusions can be drawn for the number of patients a physician faced during the study period (NPA). Based on the credibility intervals, the effect is positive for omeprazole and ciprofloxacin but negative for amlodipine. The medium and high

CPD	**Omeprazole**			**Amlodipine**			**Ciprofloxacin**		
Posterior	mean	percentiles		mean	percentiles		mean	percentiles	
		2.5	97.5		2.5	97.5		2.5	97.5
PD	0.05	0.04	0.05	0.03	0.03	0.04	0.03	0.02	0.03
GP	-0.00	-0.01	0.00	0.00	-0.00	0.01	0.01	0.01	0.02
NPA	0.01	0.00	0.01	-0.02	-0.03	-0.02	0.01	0.00	0.01
DEDM	0.02	0.01	0.03	0.03	0.02	0.04	0.00	-0.01	0.01
DEDH	0.04	0.03	0.06	0.05	0.02	0.07	0.01	-0.00	0.02
HMO	0.01	0.00	0.02	-0.01	-0.03	0.01	-0.02	-0.03	-0.00
GATE	0.01	0.00	0.02	0.02	0.01	0.04	0.00	-0.01	0.01
RUR	-0.00	-0.01	0.01	0.01	0.00	0.02	0.00	-0.00	0.01
FRIT	0.01	0.00	0.01	0.01	-0.00	0.01	-0.01	-0.01	-0.00
Y06	-0.04	-0.04	-0.03	-0.34	-0.34	-0.33	-0.21	-0.22	-0.21
Y07	-0.09	-0.09	-0.08	-0.52	-0.52	-0.51	-0.27	-0.27	-0.26
AGE	-0.02	-0.03	-0.02	0.00	0.00	0.00	-0.00	-0.00	-0.00
MALE	-0.02	-0.03	-0.02	-0.03	-0.03	-0.03	-0.07	-0.07	-0.06
DSC1	-0.73	-0.74	-0.73	-0.38	-0.39	-0.37	-0.28	-0.28	-0.27
DSC2	-0.78	-0.79	-0.78	-0.42	-0.43	-0.42	-0.19	-0.20	-0.19
DSC3	-0.97	-0.98	-0.96	-0.44	-0.45	-0.43	-0.20	-0.21	-0.19
DSC4	-0.86	-0.87	-0.85	-0.53	-0.54	-0.52	-0.31	-0.33	-0.30
CONST	5.35	5.34	5.36	5.52	5.51	5.52	2.55	2.55	2.56
Number of observations			72,488			40,749			66,236
Number of physicians			7,314			5,919			7,675
Specification: gamma GLM family (F) with logarithmic link function (g)									

Note: To facilitate simulation, the two explanatory variables number of patients (NPA) and patient age (AGE) were standardized to have $E[x] = 0$, $Var[x] = 1$.

Table 6.5: Cost-per-dose estimates – hierarchical Bayes GLM results

deductible categories (DEDM, DEDH) control for patients with better latent health status who are expected to be less likely to suffer from chronic diseases with a lower likelihood for high drug demand. Hence, they can be supplied with less cost-efficient packages due to discounting of large packages. Indeed, there is empirical evidence supporting this expectation in the case of omeprazole and amlodipine. For ciprofloxacin the mean effect is not statistically different from zero. Heterogeneity in cost awareness among patients is modeled by including alternative health insurance contracts like HMO and gatekeeping (GATE). HMO-insured patients have between 2 and 3 percent lower MPD values. However, omeprazole constitutes an exception where a positive correlation is found. The MPD of a gatekeeping insured is not statistically different from the one of a basic insured, which is also true for differences between rural and urban practices (RUR). For omeprazole and amlodipine, the MPD is higher for practices located in French- and Italian-speaking areas (FRIT) compared to German-speaking regions. However, ciprofloxacin contradicts this finding so that no clear statement can be made without further analysis of additional substances. Having a higher share of prescriptions in 2006 (Y06) and 2007 (Y07) decreases the MPD as expected due to price reductions over time. Further, elderly patients receive packages with a lower MPD, which can be explained in analogy to the deductible categories. Elderly patients may receive the drugs because of chronic diseases or simply having a higher drug demand so that they can be supplied with larger cost-efficient packages. Surprisingly, MPD for males are significantly lower. The drug-specific constants (DSCs) have expected signs and magnitudes considering the lower manufacturer prices of generic drugs.

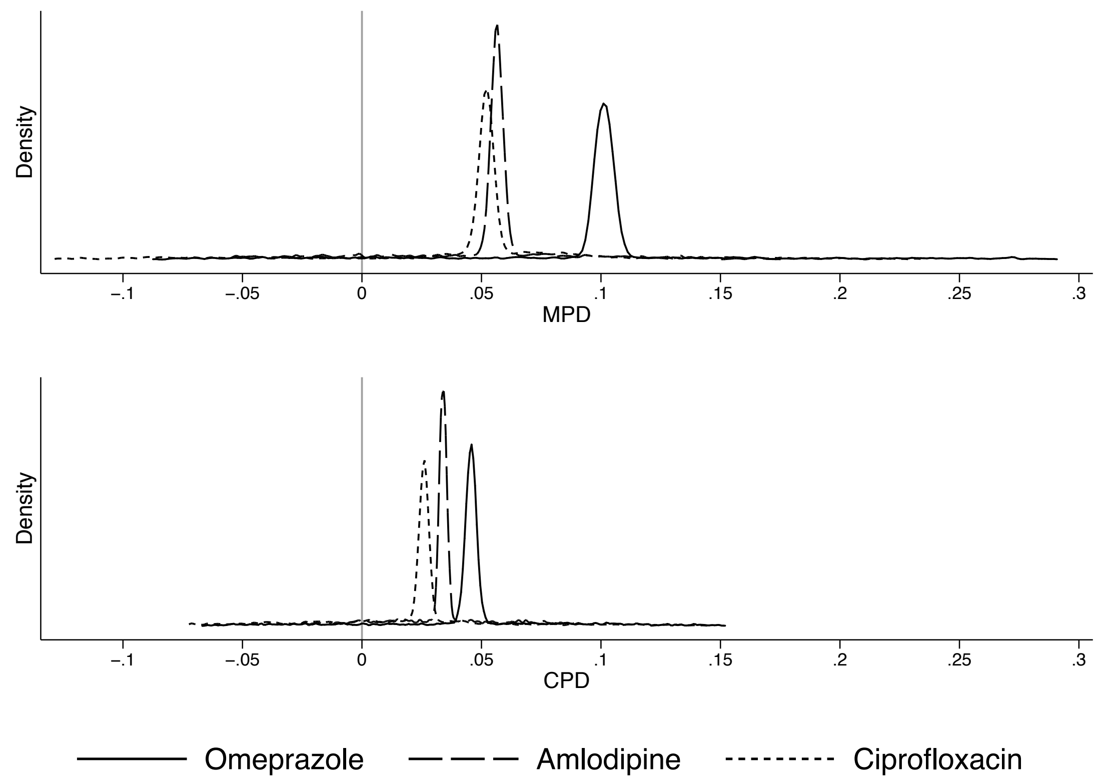

Figure 6.2: Dispersion of physician-specific PD effects (ξ_p)

6.6.2 Differences in cost-per-dose values

Regarding the effect of combining drug prescription and dispensation on pharmaceutical expenditure, the outcome variable of interest is cost per dose (CPD) prescribed. Again, cost is defined to be equal to the sales price in this study. Other costs like pharmacy fees are neglected here. If one is interested in assessing the overall cost-efficiency of combined drug delivery other potential sources for cost savings should be considered, e.g. generic substitution. The estimated semi-elasticities (see Table 6.5) signify that physician dispensing increases pharmaceutical expenditure due to inefficient package choice. The estimated posterior means of ξ's for PD with respect to CPD are 4.6 percent (omeprazole), 3.4 percent (amlodipine), and 2.6 percent (ciproflocaxin). Again, all 95%-credibility intervals do not include zero and the lowest 2.5 percentile is found for ciprofloxacin (2.0 percent) while the highest 97.5 percentile is estimated for omeprazole (5.4 percent). The shares of positive physician-specific ξ_p's are 81 (ciprofloxacin), 88 percent (omeprazole), and 89 percent (amlodipine). These results point at increasing pharmaceutical expenditure through physician dispensing if one considers only package choice. However, generic substitution and other potential savings (see above) could overcompensate these costs. In addition, even in the case of higher pharmaceutical cost, patients' willingness to pay for easier access to pharmaceuticals may be higher than additional cost and therefore legitimate physician dispensing. In Switzerland, a referendum in 2009 revealed that citizens have a strong preference in favor of dispensing physicians.

6.7 Conclusions

While many countries separate drug prescription and dispensation to ensure independent drug choice, some countries grant the authority to physician to dispense or pharmacists to prescribe drugs on their own account. On the one hand, it serves as an instrument to facilitate access to pharmaceuticals in rural areas or to make greater use of pharmacist skills and specialization to improve system flexibility with respect to prescribing, supply, and administration of medicines. On the other hand, a potential drawback of combining drug prescription and dispensation rises from drug margin optimization by combined drug provider, which may lead to higher pharmaceutical expenditure due to an inappropriate prescription of packages.

This study seeks to answer two questions. First, which role does the pharmaceutical pricing mechanism play in setting financial incentives for combined drug providers to conduct margin optimization? Second, is there empirical evidence for margin optimization of dispensing physicians in Switzerland? The theoretical part shows that the package margin component incentivizes margin optimizing provider to reduce package size in return for a higher quantity of packages. In the case of Switzerland, the per package component is likely to be high enough to set such an incentive. The hierarchical Bayes GLMs estimates in the empirical part of the paper support the expected positive correlation between physician dispensing and logistic drug margin per dose (MPD) as well as pharmaceutical cost per dose (CPD). For MPD, the posterior means of the semi-elasticities with respect to the physician-dispensing dummy are between 5.2 and 10.1 percent while all 95%-credibility intervals do not include zero. Physician-specific semi-elasticities reveal that for 85 to 89 percent physician dispensing has a positive effect on MPD. The CPD is between 2.6 and 4.6 percent higher for dispensing physicians indicating that profit considerations lead to higher drug expenditure due to inappropriate package choice. However, combining drug prescription and dispensation could lower pharmaceutical bills through other cost savings. Thus, the study does not allow a general statement about cost-efficiency of combined drug provision. The evidence that dispensing physicians receive higher logistic margins than pharmacists points at imperfect agency and margin optimization activities most likely arising because of a per package margin component.

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Appendix

	Package size (*S*)				Dosage (*D*)		
	2×	3×	4×	5×	2×	3×	4×
Discount rate	0.12	0.15	0.18	0.21	0.18	0.24	0.30
Linear price, $P^l = \delta P^r$	$\delta = 2.00$	3.00	4.00	5.00	2.00	3.00	4.00
Discounted price, $P^d = \delta P^r$	$\delta = 1.76$	2.55	3.28	3.95	1.64	2.28	2.80

Source: FOPH (2008). P^r denotes the reference price of the smallest package provided (1×). Then, e.g. 2× indicates a package containing twice as many pills or double dose per pill.

Table 6.6: Drug price relations in Switzerland

Chapter 7

Conclusions

Industrialized countries have been spending an increasing share of their economic resources on health care. Switzerland is no exception as its health care expenditure is growing at a faster rate than its gross domestic product. Spending per capita and expenditure as a share of gross domestic product is only higher in the United States and France, calling for health care reforms. Nevertheless, high costs are not evil per se. As long as society's preferences indicate a willingness to pay such high premiums for health care, cutting health care provision does not contribute to a gain in social welfare. Thus, the elicitation of citizens' preferences for health care permits us to evaluate the extent of justifiable health care expenditure from a societal perspective. In contrast, provider preferences can be used to estimate potential reductions in health care expenditure through reforms. Measuring willingness-to-pay (or willingness-to-accept) values permits the comparison of cost of changes in health care provision with any potential benefits. Furthermore, investigating provider preferences helps to understand the choice of medical services provided and to explain cost differences.

Stated-choice surveys are used to measure provider preferences (Chapters 2 and 3) and consumer preferences (Chapter 4). Chapter 2 shows that even if Swiss private-practice physicians like some Managed Care (MC) attributes, most of them require compensation payments by insurers to be applied. Regarding the implementation of cost sharing between insurers and providers, the former must be able to achieve substantial savings in order to create sufficient incentives to attract ambulatory care physicians to join networks with budgetary co-responsibility (Chapter 3). General resistance against network participation constitutes a prohibitive price to be paid by insurers wanting to attract enough physicians to participate in networks. On the consumer side, individuals purchasing health insurance have be to won over to accept MC-type restrictions as well. Chapter 4 measures the preferences of German and Dutch residents for alternative insurance policies. Of interest is the extent to which premiums have to decrease in order to give up free physician choice and to accept a contract including gatekeeping or accepting gatekeeping combined with a list of specialists participating in the relevant network. Again, required premium reductions are high, lowering potential savings through MC. Similar results can be expected for Swiss citizens. In sum, MC is unlikely to have its expected cost limiting effect. This conclusion applies at least as long as MC participation is voluntary for providers and consumers and conventional practice remains an available alternative.

In contrast to stated preferences, revealed preferences are measured using observed instead of hypothetical choices. This type of preferences is measured using drug claims data. Chapter 5 investigates if prescriber's financial interests affect prescriber's preferences in favor of brand-name or generic drugs. Measuring these preferences allows testing physicians' imperfect agency. The results indicate a significant and positive association between physician dispensing and the market share for generics in Switzerland. While this points at imperfect agency, generics are more often prescribed to patients with high copayments or low incomes. In contrast, Chapter 6 analyzes if drug margin optimization is performed by dispensing physicians and if preference heterogeneity for different package versions is traceable. Conditioned on drug brand, dispensing physicians in Switzerland achieve higher profits from drug dispensing than pharmacies.

The studies presented in this dissertation could form the basis for the extension of future research. The discrete choice experiments to elicit respondents' taste parameters (Chapters 2, 3, and 4) are all estimated using random-coefficient logit models. Modeling random coefficients requires us to make assumptions about how these coefficients are distributed among respondents, representing preference heterogeneity. Current research focuses on how distributional assumptions affect estimation results [compare Hess et al. (2005)]. Further, the assumption of multivariate normally distributed utility weights is increasingly considered to be a poor choice for modeling taste heterogeneity. According to Fiebig et al. (2009), much of the preference heterogeneity is accounted for by a pure scale effect. Thus, they recommend the application of a generalized multinomial logit model that allows for taste and scale heterogeneity. Unfortunately, this model was not implemented in any statistical software package at the time this dissertation was written. In future, one could reestimate the discrete choice experiments from Chapters 2, 3, and 4 allowing for preference and scale heterogeneity.

Physician payment mechanisms can be designed using attributes other than the ones discussed in Chapter 3. Physicians could prefer e.g. a bonus/malus defined in absolute instead of relative values because financial risk is limited.

Chapters 5 and 6 do not control for a potential endogeneity problem of being a dispensing physician or not. Physicians who want to derive additional income from drug dispensing could locate their practices in areas where physician dispensing is allowed. If such a selection effect is present, the estimated preferences for generic drugs might be biased upwards. However, data were not available to control for such a selection effect.

An alternative approach to investigate drug margin optimization and its effect on pharmaceutical expenditure discussed in Section 6 is to model discrete choices between packages, e.g. small versus medium versus large, or to estimate count data models to explain differences in e.g. number of prescribed packages or total pills. However, Section 6 uses margin-per-dose values because it has the advantage of combining different sources of margin optimization into one single measure.

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Curriculum Vitae

Maurus Rischatsch was born on the 31^{st} of October 1980 in Chur, Switzerland. He studied Economics at the University of Zurich and the Turku School of Economics in Finland. From 2007 to 2011 he was a Ph.D. student and research assistant at the Department of Economics with Professor Dr. Peter Zweifel (Chair for Applied Microeconomics). In 2010, he spent six months as a visiting scholar at the Nicolas C. Petris Center for Health Care Markets and Consumer Welfare and the School of Public Health of the University of California, Berkeley. As a part of his doctoral studies, he successfully completed the International Doctoral Program in Health Economics and Policy provided by the Swiss School of Public Health. He presented his work at the 8^{th} European Conference on Health Economics in Helsinki (2010), the 3^{rd} Conjoint Analysis Conference in Newport Beach (2010), and at the 8^{th} World Congress on Health Economics in Toronto (2011). During his time as a research assistant at the Department of Economics he supervised various university courses and worked freelance for consulting companies carrying out several projects such as regulatory impact analyses.